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The publications of the National Museum consist of two series: Proceedings and Bulletins.

The Proceedings, the first volume of which was issued in 1878, are intended primarily as a medium of publication for newly-acquired facts in biology, anthropology, and geology, descriptions of new forms of animals and plants acquired by the National Museum, discussions of nomenclature, etc. A volume is issued annually or oftener for distribution to libraries, while in view of the importance to science of the prompt publication of descriptions of new species, a limited edition of each paper is printed in pamphlet form in advance.

The present volume is the twenty-fifth of the series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately and based for the most part upon collections in the National Museum. They are monographic in scope, and are devoted principally to the discussion of large zoological groups, bibliographies of eminent naturalists, reports of expeditions, etc.

A quarto form of the Bulletin, known as the "Special Bulletin," has been adopted in a few instances in which a larger page was deemed indispensable.

The Annual Report of the National Museum (being the second volume of the Smithsonian Report) contains papers chiefly of an ethnological character, describing collections in the National Museum.

Papers intended for publication by the National Museum are usually referred to an advisory committee, composed as follows: Frederick W. True (chairman), William H. Holmes, George P. Merrill, James E. Benedict, Otis T. Mason, Leonhard Stejneger, Lester F. Ward, and Marcus Benjamin (editor).

S. P. LANGLEY,
Secretary of the Smithsonian Institution.

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- SMITH, JOHN B. Contributions Toward a Monograph of the Lepidopterous Family Noctuidæ of Boreal North America. A Revision of the Moths Referred to the Genus *Leucania*, with Descriptions of New Species.—No. 1283. September 13, 1902^a 159-209
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A LIST OF THE BEETLES OF THE DISTRICT OF COLUMBIA.

By HENRY ULKE.

I. INTRODUCTION.

The following list of the Coleoptera of the District of Columbia is the result of a diligent search extending over a period of nearly forty years.

In the fifties, the city of Washington was still surrounded by many fine woods and lovely meadows, which promised the entomologist and botanist a rich harvest. In truth, almost every collecting excursion in those days furnished abundant new material and raised the interest and enthusiasm of the collector to a high pitch.

With the beginning of our civil war, the woods on the Virginia side of the Potomac began to disappear, and not many years later the pleasant fields and woods north and northwest of the city were occupied by city extensions, avenues, and building lots, so that one hunting ground after the other was captured by advancing civilization.

Nevertheless the right bank of the Potomac, between the Aqueduct Bridge and Little Falls, remained a rich field for the collector until quite recently, when it, too, began to suffer from the inroads of the stone quarrymen and others.

As a result of the destruction of forests and meadows, a number of beetles seem to have disappeared, which were formerly quite common, such as *Boros unicolor*, *Doryphora juncta*, and *Laricobius erichsoni*, while other species were introduced with the extension of agriculture and horticulture. Among the introduced species, some have multiplied so fast that they may now fairly be considered pests, such as *Phytonomus punctatus* and *Sitones hispidulus*. A large portion of the District, however, still remains unexplored, and only recently the southeastern region, toward Marlboro, furnished botanists several species not previously enumerated in Lester F. Ward's excellent List of the Flora of Washington and Vicinity.

The northeastern region, in the neighborhood of Odenton, should also be studied more carefully, as, for example, the sand dunes there constitute the only places where the rare *Cremastochilus leucostictus* was found.

Notwithstanding the attendant difficulties and large extent of unexplored territory to furnish a nearly complete list of the Coleoptera of the District of Columbia, I must acknowledge that success is in part due to the encouragement of my friend, E. A. Schwarz, who kindly lent his wide experience and assistance in preparing the annexed biological notes.

The following important facts have been observed concerning the relation existing between the local geology, flora, and general fauna and the occurrence of the District beetles in special.

It is a well-known fact that the distribution and varied habits of Coleoptera afford such striking features that the general physical characteristics of any locality can be determined from an average collection of the beetles of such region.

The number of species found in the District of Columbia, or, more broadly, in an area within a radius of 20 miles of the Capitol, is not less than 3,000. This is a much larger number than has been recorded from local lists of any other equal area in the United States. It represents about one-fourth of the total number of species now recorded from North America north of the Mexican boundary.

Let us now examine the physical conditions which form the environment of the Coleoptera here.

The geology of the District presents the following features:

Washington City is chiefly built upon thin beds of sedimentary sands, clays, or gravels of the Post-Jurassic age, covering the Archean crystalline rocks—chiefly gneiss and granite.

Satisfactory exposures of these rocks are to be found only in the deep ravines cut by the Potomac and Rock Creek or their tributaries, since, at the surface of the Washington plateau, their character has been obscured or obliterated by extensive superficial decay and by cultivation.

Toward the west the gneisses, which are for the most part granitoid in character and possess a north-south strike, become somewhat more foliated and schistose. In many places it appears that the granites and gneisses have been subjected to extensive metamorphism. Near Georgetown and Cabin John occur pronounced developments of a massive dark-green diorite, and in other localities are found bands of siliceous and chloritic schists. These, however, grade imperceptibly into the prevailing granite and gneiss, and probably represent the result of intense dynamic action. Limited occurrences of gabbro, serpentine, and steatite complete the list of eruptive rocks found in the District. Altogether they contain at least forty different mineral species.

The soil formed by the decomposition of the above sediments and rocks is so varied in character that it is able to support no less than 1,400 species and varieties of vascular plants.

Now, as about half of all the beetles depend upon plants for their food, the greater the variety of food plants the larger we find the number of species of beetles.

The geographical position and topographical features of the District of Columbia also largely account for its diversified insect fauna.

The coastal plain deposits, concealing the crystalline rocks of the eastern and southern portions of the District, are formed into numerous terraces, so that Washington is surrounded by low hills on all sides, except where the Eastern Branch and southeastern shores of the Potomac flatten out into marshy grounds.

As the District lies on the border of the crystalline plateau and the lower coastal formation and at the head of tide water on the great lowland plain, which extends from New York to Richmond, the local fauna has the composite character belonging to the upper austral, lower austral, and the transition zones, or, to be more exact, it has the facies of the Allegheny, Carolina, and austro-riparian regions, as classified by Dr. C. Hart Merriam.¹

In a region so restricted and comparatively level, there are of course no such changes in the temperature as in mountainous countries, where we find forms of insects on the top of mountains very different from those below, the former being always of a more northern type. The appearance of northern and southern forms are here controlled by the change of seasons, so in early spring we may always expect more northern types, while in midsummer the southern ones predominate.

There are other local causes which influence the character of our fauna. The Potomac River every spring carries down quantities of flood débris from the mountain districts, containing insects which properly belong to higher elevations, for example, *Phelopsis obcordata*, *Pinodytes cryptophagoides*, *Carcbara longula*, *Enchodes sericea*, and several Carabidæ, Longicorns, and Elateridæ. Southern forms have been observed chiefly in the middle and eastern part of the District as along the Eastern Branch, where species were collected, such as *Cassonia ludoviciana*, *Cymindis elegans*, *Thalpius dorsalis*, and several Chrysomelidæ.

The great attraction of the electric lights for insects has also resulted in the discovery of certain kinds, whose occurrence here was not previously known with certainty, such as *Omophron labiatum*, *Clivina punctigera*, *Platynus picticornis*, *Rhantus calidus*, *Atanius figurator*, *Pleurophorus ventralis*, and *Donacia hypoleuca*, which belong to the austroriparian fauna.

¹The geographical Distribution of Animals and Plants in North America. Bull. Nat. Geog. Soc., 1895.

To convey a correct impression of the geographical distribution of the beetles, it is absolutely essential to obtain accurate lists of the Coleoptera of the different sections of this country. The first step in this direction was taken by Messrs. E. A. Schwarz and H. G. Hubbard, who prepared the Coleoptera of Michigan and Florida, and their example was followed by numerous other entomologists. Of special interest for comparison is Dr. John Hamilton's Catalogue of the Coleoptera of Southwestern Pennsylvania (1895).

There are especially three localities in the immediate vicinity of Washington which have been very carefully explored by the entomologists: The meadows, rocks, and woods along both sides of the Potomac and including the river flats across Long Bridge; the valleys of the Rock Creek, and the banks of Eastern Branch. The richest collecting ground near Washington has been the rocky ledges and ravines along the south banks of the Potomac just above the Free Bridge. The Rock Creek region is also full of interest. The creek cutting its snake like course here through solid rocks, leaves deep ravines and winds its way among mossy sand banks and swampy meadows, presenting a variety of conditions that always assures the collector a rich harvest. In striking contrast to the above localities are the banks of the Eastern Branch, with their extensive marshes of wild rice. Here a great many species were found not occurring elsewhere in the District.

Some representative forms of the austroriparian fauna are found all along the Atlantic coast from Florida to New Jersey, but the majority do not extend more northerly than the Chesapeake region, while certain northern species find their southern limit of distribution in this vicinity.

The following are examples of austroriparian species which find here their northern limit:

Omophron labiatum, *Platynus striatopunctatus* and *picicornis*, *Anatrichis minuta*, *Celina angustata*, *Bryaris helfragei*, *Ino reclusa*, *Meristhus scobinula*, *Ischiodontus solcatus*, *Ozognathus floridanus*, *Edionychis indigoptera*, *Lactica tibialis*, *Mecynotarsus candidus*, *Xylophilus notatus*, *Hyporhagus punctulatus*, *Liopus crassulus*, *Aulentes tachygonoides*, *Ceutorhynchus siculus*, *Oomorhynchus lævicollis*, *Chaetocalus setosus*, and others.

Of Alleghenian forms, which find here their southern limit, we have: *Cicindela rugifrons*, *Lebia fuscata*, *Ips confluentus*, *Boros unicolor*, *Laricobius erichsoni*, *Rhinosimus viridiæneus*, *Carebara longula*, *Enchodes sericea*, *Pterostichus corvinus*, *Platynus obsoletus*, *Acalyptus carpini*, and others.

The great bulk of our Coleoptera, however, belongs to the carolinian fauna.

As this manuscript was prepared nearly four years ago, papers on North American Coleoptera that have been published since have not been taken into consideration. Some of the changes in the nomenclature established in these papers have been inserted, but many others could not be attended to.

Everyone familiar with the systematic study of North American Coleoptera is aware that in many genera of various families we have a larger or smaller number of undescribed species; the description of which must by all means be left for future monographs. Such species are omitted in this list; they are most numerous in the subfamily Aleocharinæ of the family Staphylinidæ, in the Cioidæ, Cryptoplagidæ, etc.

A local faunal list acquires interest and importance only when compared with lists of adjacent regions. As to Coleoptera we have the list by the late Dr. John Hamilton¹ on the Coleoptera of southwestern Pennsylvania, and that of Dr. J. B. Smith on the insects of New Jersey (second edition, 1899.) Both of these lists refer to regions north of the District of Columbia. Southward we have no comprehensive faunal lists of Virginia, North Carolina, South Carolina, and Georgia. The list of Coleoptera of Florida, by Schwarz and Hubbard² is also of importance for comparison with our District fauna.

It is very gratifying to find that some of the younger enthusiastic students in the Division of Insects in the United States National Museum, and the Division of Entomology in the United States Department of Agriculture, such as H. S. Barber and F. C. Pratt, have taken up coleopterology and already give proof of their success in studying and collecting coleoptera. No doubt many additions will hereafter be made to the species enumerated in this paper.

LIST OF SPECIES.

CICINDELIDÆ.

1. *Tetracha virginica* Linnæus.
2. *Cicindela rugifrons* Dejean.
3. *6-guttata* Fabricius.
4. var. *patruela* Dejean.
5. *purpurea* Olivier.
6. var. *splendida* Hentz.
7. *vulgaris* Say.
8. *repanda* Dejean.
9. var. *12-guttata* Dejean.
10. *hirticollis* Say.
11. *punctulata* Fabricius.
12. *marginata* Fabricius.
13. *rufiventris* Dejean.

CARABIDÆ.

14. *Omiopron labiatum* Fabricius.
15. *americanum* Dejean.
16. *Cychnus stenostomus* Weber.
17. *elevatus* Fabricius.
18. *unicolor* Olivier.
19. *viduus* Dejean.
20. *Carabus sylvosus* Say.
21. *serratus* Say.
22. *limbatus* Say.
23. *vinctus* Weber.
24. *Calosoma externum* Say.
25. *scrutator* Fabricius.
26. *wilcoxi* Le Conte.

¹ Trans. Amer. Ent. Soc., XXII, 1895.² Proc. Amer. Phil. Soc., XVII, 1878.

LIST OF SPECIES—Continued.

27. *Catoloma saji* Dejean.
 28. *calidum* Fabricius.
 29. *Elaphrus riparius* Linnæus.
 30. *ruscarius* Say.
 31. *Notiophilus aeneus* Herbst.
 32. *semistriatus* Le Conte.
 33. *sibiricus* Motschulsky.
 34. *Nebria pallipes* Say.
 35. *Pasimachus sublarvis* Dejean.
 36. *depressus* Fabricius.
 37. *Scarites subterraneus* Fabricius.
 38. *Dyschirius globulosus* Say.
 39. *hemorrhoidalis* Dejean.
 40. *sphericollis* Say.
 41. *pumilus* Putzeys.
 42. *pilosus* Le Conte.
 43. *Clivina dentipes* Dejean.
 44. *impressifrons* Le Conte.
 45. *planicollis* Le Conte.
 46. *punctigera* Le Conte.
 47. *pallida* Say.
 48. *rufa* Le Conte.
 49. *americana* Dejean.
 50. *morula* Le Conte.
 51. *ferrea* Le Conte.
 52. *bipustulata* Fabricius.
 53. *Aspidoglossa subangulata* Chaudoir.
 54. *Schizogenius livolatus* Say.
 55. *ferrugineus* Putzeys.
 56. *amphibius* Haldeman.
 57. *Panagæus fuscatus* Say.
 58. *Bembidium punctatostriatum* Say.
 59. *littorale* Olivier.
 60. *inæquale* Say.
 61. *corendix* Say.
 62. *larigatum* Say.
 63. *americanum* Dejean.
 64. *antiquum* Dejean.
 65. *chalcum* Dejean.
 66. *nigrum* Say.
 67. *fugax* Le Conte.
 68. *guerii* Chaudoir.
 69. *ustulatum* Linnæus.
 70. *picipes* Kirby.
 71. *fraternum* Le Conte.
 72. *dorsale* Say.
 73. *patrule* Dejean.
 74. *variegatum* Say.
 75. *constrictum* Le Conte.
 76. *contractum* Say.
 77. *affine* Say.
 78. *4-maculatum* Linnæus.
 79. *Bembidium pedicellatum* Le Conte.
 80. *semistriatum* Haldeman.
 81. *Anillus fortis* Horn.
 82. *Tachys proximus* Say.
 83. *scitulus* Le Conte.
 84. *corruscus* Le Conte.
 85. *pumilus* Dejean.
 86. *lævus* Say.
 87. *nanus* Gyllenhal.
 88. *flavicauda* Say.
 89. *tripunctatus* Say.
 90. *rivax* Le Conte.
 91. *capax* Le Conte.
 92. *rauthopus* Dejean.
 93. *ferrugineus* Dejean.
 94. *incavrus* Say.
 95. var. *pulchellus* Laferté.
 96. *granarius* Dejean.
 97. *dolosus* Le Conte.
 98. *Pericompsus ephippiatus* Say.
 99. *Patrobis longicornis* Say.
 100. *Myas coracinus* Say.
 101. *Pterostichus adoxus* Say.
 102. *rostratus* Newman.
 103. *rotundatus* Le Conte.
 104. *approxinatus* Le Conte.
 105. *diligendus* Chaudoir.
 106. *honestus* Say.
 107. *lachrymosus* Newman.
 108. *coracinus* Newman.
 109. *stygius* Say.
 110. *merstus* Say.
 111. *saji* Brullé.
 112. *lucublandus* Say.
 113. *ebeninus* Dejean.
 114. *caudicilis* Say.
 115. *luctuosus* Dejean.
 116. *corvinus* Dejean.
 117. *gearis* Le Conte.
 118. *mutus* Say.
 119. *erythropus* Dejean.
 120. *femorialis* Kirby.
 121. *Erethrus sigillatus* Say.
 122. *sodalis* Le Conte.
 123. *Amara arida* Say.
 124. *fulripes* Putzeys.
 125. *exarata* Dejean.
 126. *angustata* Say.
 127. *impuncticollis* Say.
 128. *basillaris* Say.
 129. *crassispina* Le Conte.
 130. *cupreolata* Putzeys.

LIST OF SPECIES—Continued.

131. *Amara fallax* Le Conte.
 132. *interstitialis* Dejean.
 133. *chalcea* Dejean.
 134. *rubrica* Haldeman.
 135. *musculus* Say.
 136. *Loxandrus rectus* Say.
 137. *minor* Chaudoir.
 138. *erraticus* Dejean.
 139. *agilis* Dejean.
 140. *Diplochila laticollis* Le Conte.
 141. *Dicelus dilatatus* Say.
 142. *purpuratus* Bonelli.
 143. *oralis* Le Conte.
 144. *elongatus* Bonelli.
 145. *ambiguus* Laferté.
 146. *teter* Bonelli.
 147. *politus* Dejean.
 148. *Badister notatus* Haldeman.
 149. *pulchellus* Le Conte.
 150. *maculatus* Le Conte.
 151. *flavipes* Le Conte.
 152. *reflexus* Le Conte.
 153. *Calathus gregarius* Say.
 154. *opaculus* Le Conte.
 155. *impunctatus* Say.
 156. *Platypus caudatus* Le Conte.
 157. *decens* Say.
 158. *sinuatus* Dejean.
 159. *cincticollis* Say.
 160. *reflexus* Le Conte.
 161. *extensicollis* Say.
 162. *decorus* Say.
 163. *marens* Dejean.
 164. *melanarius* Dejean.
 165. *carbo* Le Conte.
 166. *cupripennis* Say.
 167. *excavatus* Dejean.
 168. *ferreus* Haldeman.
 169. *nutans* Say.
 170. *striatopunctatus* Dejean.
 171. *picicornis* Newman.
 172. *8-punctatus* Fabricius.
 173. *placidus* Say.
 174. *bogenmanni* Gyllenhal.
 175. *aruginosus* Dejean.
 176. *limbatus* Say.
 177. *punctiformis* Say.
 178. *crenistriatus* Le Conte.
 179. *rubripes* Zimmermann.
 180. *picipennis* Kirby.
 181. *luteiventris* Le Conte.
 182. *Olisthopus parvatus* Say.
 183. *micans* Le Conte.
 184. *Perigona nigriceps* Dejean.
 185. *pallipennis* Le Conte.
 186. *Atranes pubescens* Dejean.
 187. *Leptotrachelus dorsalis* Fabricius.
 188. *Casnonia pennsylvanica* Linnaeus.
 189. *hudsoniana* Sallé.
 190. *Galericia janus* Fabricius.
 191. *bicolor* Drury.
 192. *Thalpius dorsalis* Brullé.
 193. *Tetragonoderus fasciatus* Haldeman.
 194. *Lebia grandis* Hentz.
 195. *atriventris* Say.
 196. *tricolor* Say.
 197. *pulchella* Dejean.
 198. *marginicollis* Dejean.
 199. *viridis* Say.
 200. var. *maesta* Le Conte.
 201. *pumila* Dejean.
 202. *pleuritica* Le Conte.
 203. *viridipennis* Dejean.
 204. *lobulata* Le Conte.
 205. *ornata* Say.
 206. *analis* Dejean.
 207. *fuscata* Dejean.
 208. *abdominalis* Chaudoir.
 209. *scapularis* Dejean.
 210. *depicta* Horn.
 211. *pectita* Horn.
 212. *bivittata* Fabricius.
 213. *Coptodera arata* Dejean.
 214. *Dromius picus* Dejean.
 215. *Apristus cordicollis* Le Conte.
 216. *subsulcatus* Dejean.
 217. *Blechnus glabratus* Duftschmid.
 218. *pustio* Le Conte.
 219. *Metabletus americanus* Dejean.
 220. *Plochionus timidus* Haldeman.
 221. *Pinacodera limbata* Dejean.
 222. *platicollis* Say.
 223. *Cymindis elegans* Le Conte.
 224. *americana* Dejean.
 225. *pilosa* Say.
 226. *neglecta* Haldeman.
 227. *Apenes lucidula* Dejean.
 228. *sinuata* Say.
 229. *Helluomorpha nigripennis* Dejean.
 230. *bicolor* Harris.
 231. *Brachypus americanus* Le Conte.
 232. *minutus* Harris.

LIST OF SPECIES—Continued.

233. *Brachynus perplexus* Dejean.
 234. *ballistarius* Le Conte.
 235. *fumans* Fabricius.
 236. *Chlaenius scriceus* Forster.
 237. *laticollis* Say.
 238. *astivus* Say.
 239. *prasinus* Dejean.
 240. *leucoscelis* Chevrolat.
 241. *nemorialis* Say.
 242. *tricolor* Dejean.
 243. *brevilabris* Le Conte.
 244. *pennsylvanicus* Say.
 245. *impunctifrons* Say.
 246. *niger* Randall.
 247. *tomentosus* Say.
 248. *emarginatus* Say.
 249. *caeruleicollis* Chaudoir.
 250. *Brachylobus lithophilus* Say.
 251. *Lachnocrepis parallelus* Say.
 252. *Anatrichis minuta* Dejean.
 253. *Oodes amaroides* Dejean.
 254. *americanus* Dejean.
 255. *Evolenes exaratus* Dejean.
 256. *Geopinus incrassatus* Dejean.
 257. *Cratacanthus dubius* Beauvois.
 258. *Agonoderus lineola* Fabricius.
 259. *pallipes* Fabricius.
 260. *comma* Fabricius.
 261. *pauperculus* Dejean.
 262. *indistinctus* Dejean.
 263. *testaceus* Dejean.
 264. *micrus* Le Conte.
 265. *Discoderus tenebrosus* Le Conte.
 266. *Gymnandropus hylacis* Say.
 267. *Harpalus dichrous* Dejean.
 268. *vulpeculus* Say.
 269. *autumnalis* Say.
 270. *erraticus* Say.
 271. *caliginosus* Fabricius.
 272. *fauvus* Say.
 273. *pennsylvanicus* De Geer.
 274. var. *compar* Le Conte.
 275. var. *longior* Kirby.
 276. var. *erythropus* Dejean.
 277. *spadicus* Dejean.
 278. *herbivagus* Say.
 279. *nitidulus* Chaudoir.
 280. *viduus* Le Conte.
 281. *Selenophorus pedicularius* Dejean.
 282. *gagatinus* Dejean.
 283. *opalinus* Le Conte.
 284. *Selenophorus ellipticus* Dejean.
 285. *Stenolophus carbonarius* Brullé.
 286. *spretus* Dejean.
 287. *fuliginosus* Dejean.
 288. *pebejus* Dejean.
 289. *conjunctus* Say.
 290. *humidus* Hamilton.
 291. *ochropezus* Dejean.
 292. *alternans* Le Conte.
 293. *Acupalpus hydropicus* Le Conte.
 294. *curus* Le Conte.
 295. *rectangulus* Chaudoir.
 296. *Bradycellus linearis* Le Conte.
 297. *rupestris* Say.
 298. var. *parallelus* Chaudoir.
 299. *tantillus* Chaudoir.
 300. *nigriceps* Le Conte.
 301. *Tachycellus badipennis* Haldeeman.
 302. *atrimedius* Say.
 303. *Anisodactylus rusticus* Say.
 304. *carbonarius* Say.
 305. *agricola* Say.
 306. *nigerrimus* Dejean.
 307. *nigrita* Dejean.
 308. *discoides* Dejean.
 309. *baltimorensis* Say.
 310. *latus* Dejean.
 311. *census* Say.
 312. *sericeus* Harris.
 313. *Nestonotus lugubris* Dejean.
 314. *Anaphasia interstitialis* Say.
 315. *Anisotarsus terminatus* Say.
 316. *nitidipennis* Le Conte.
 317. *Spongopus verticalis* Le Conte.
- HALIPLID.E.
318. *Haliphus fasciatus* Aubé.
 319. *punctatus* Aubé.
 320. *triopsis* Say.
 321. *ruficollis* De Geer.
 322. *Cuenidotus simplex* Le Conte.
 323. *12-punctatus* Say.
- DYTISCID.E.
324. *Canthydrus bicolor* Say.
 325. *puncticollis* Crotch.
 326. *Hydrocauthus iricolor* Say.
 327. *Laccophilus maculosus* Germar.
 328. *fasciatus* Aubé.
 329. *proximus* Say.
 330. *undatus* Aubé.

LIST OF SPECIES—Continued.

331. *Hydrocatus pustulatus* Melsheimer.
 332. *Desmopachria convexa* Aubé.
 333. *Bidessus flavicollis* Le Conte.
 334. *affinis* Say.
 335. *lucustris* Say.
 336. *granarius* Aubé.
 337. *Celina angustata* Aubé.
 338. *Celaenus nubilus* Le Conte.
 339. *dissimilis* Gemminger and Harold.
 340. *Hydroporus concinnus* Le Conte.
 341. *pulcher* Le Conte.
 342. *mellitus* Le Conte.
 343. *inornatus* Sharp.
 344. *niger* Say.
 345. *modestus* Aubé.
 346. *oblitus* Aubé.
 347. *undulatus* Say.
 348. *consimilis* Le Conte.
 349. *proximus* Aubé.
 350. *vitiosus* Le Conte.
 351. *sericeus* Le Conte.
 352. *striatopunctatus* Melsheimer.
 353. *americanus* Aubé.
 354. *Itybius biguttulus* Germar.
 355. *Coptotomus interrogatus* Fabricius.
 356. *Copelatus glypticus* Say.
 357. *Matus bicarinatus* Say.
 358. *Agabetes aculectus* Harris.
 359. *Agabus seriatus* Say.
 360. *obtusatus* Say.
 361. *stagninus* Say.
 362. *disintegratus* Crotch.
 363. *erythropterus* Say.
 364. *gagates* Aubé.
 365. *Rhantus calidus* Fabricius.
 366. *Hydaticus bimarginatus* Say.
 367. *Dytiscus hybridus* Aubé.
 368. *Acilius medietus* Say.
 369. *Thermonectes oraticollis* Aubé.
 370. *basilaris* Harris.
 371. *Graphoderes liberus* Say.
 372. *Cybister fimbriolatus* Say.
- GYRINIDÆ.
373. *Dineutes vittatus* Germar.
 374. *carolinus* Le Conte.
 375. *assimilis* Aubé.
 376. *discolor* Aubé.
 377. *emarginatus* Say.
 378. *Dineutes nigrior* Roberts.
 379. *Gyrinus rockinghamensis* Zimmermann.
 380. *zeucolus* Le Conte.
 381. *ventralis* Kirby.
 382. *analis* Say.
- HYDROPHILIDÆ.
383. *Helophorus lineatus* Say.
 384. *inguinatus* Mannerheim.
 385. *Hydrochus scabratus* Mulsant.
 386. *inequalis* Le Conte.
 387. *subcupreus* Randall.
 388. *Hydræna pennsylvanica* Kiesenwetter.
 389. *Hydrophilus triangularis* Say.
 390. *oratus* Gemminger and Harold.
 391. *Tropisternus nimbatus* Say.
 392. *glaber* Herbst.
 393. *striolatus* Le Conte.
 394. *Hydrocharis obtusatus* Say.
 395. *Berosus peregrinus* Herbst.
 396. *exiguus* Say.
 397. *striatus* Say.
 398. *Laccobius agilis* Randall.
 399. *Phyllhydrus nebulosus* Say.
 400. *ochraceus* Melsheimer.
 401. *cinctus* Say.
 402. *perplexus* Le Conte.
 403. *Helochares maculicollis* Mulsant.
 404. *Helocombus bifidus* Le Conte.
 405. *Cymbiodyta fimbriata* Melsheimer.
 406. *blanchardi* Horn.
 407. *Hydrobius fuscipes* Linnaeus.
 408. *globosus* Say.
 409. *tesselatus* Ziegler.
 410. *Creniphilus subcupreus* Say.
 411. *suturalis* Le Conte.
 412. *Phænonotum cestratum* Say.
 413. *Cereyon unipunctatus* Linnaeus.
 414. *pratensis* Say.
 415. *indistinctus* Horn.
 416. *analis* Paykull.
 417. *analis* var. ?
 418. *lugubris* Paykull.
 419. *hæmorrhoidalis* Fabricius.
 420. *nigriceps* Marsham.
 421. *pygmaeus* Illiger.
 422. *melanocephalus* Linnaeus.
 423. *raurarius* Erichson.

LIST OF SPECIES—Continued.

424. *Cercyon navicularis* Zimmermann.
 425. *pubescens* Le Conte.
 426. *Cryptopleurum minutum* Fabricius.
 427. *americanum* Horn.
 428. *Pemelus costatus* Le Conte.

LEPTINID.E.

429. *Leptinus testaceus* Müller.

SILPHID.E.

430. *Necrophorus americanus* Olivier.
 431. *orbicollis* Say.
 432. *marginatus* Fabricius.
 433. *tomentosus* Weber.
 434. *Silpha surinamensis* Weber.
 435. *lapponica* Herbst.
 436. *inæqualis* Fabricius.
 437. *novboracensis* Forster.
 438. *americana* Linnaeus.
 439. *Pinodytes cryptophagoides* Mannerheim.
 440. *Cholera luridipennis* Mannerheim.
 441. *simplex* Say.
 442. *clavicornis* Le Conte.
 443. *terminans* Le Conte.
 444. *Prionochata opaca* Say.
 445. *Ptomaphagus consobrinus* Le Conte.
 446. *ulvæ* Horn.
 447. *oblitus* Le Conte.
 448. *parasitus* Le Conte.
 449. *Colon paralarum* Horn.
 450. *hubbardi* Horn.
 451. *putum* Horn.
 452. *pusillum* Horn.
 453. *thoracicum* Horn.
 454. *asperatum* Horn.
 455. *Anisotoma alternata* Melsheimer.
 456. *assimilis* Le Conte.
 457. *collaris* Le Conte.
 458. *obsoleta* Melsheimer.
 459. *Colenis impunctata* Le Conte.
 460. *Liodes discolor* Melsheimer.
 461. *obsoleta* Horn.
 462. *basalis* Le Conte.
 463. *geminata* Horn.
 464. *Cyrtusa picipennis* Le Conte.
 465. *blandissima* Zimmermann.
 466. *egena* Le Conte.
 467. *Isoplastus fossor* Horn.
 468. *Agathidium oniscoides* Beauvois.
 469. *exiguum* Melsheimer.

470. *Aglyptus larvis* Le Conte.
 471. *Clambus gibbulus* Le Conte.
 472. *puberulus* Le Conte.

SCYDMENID.E.

473. *Chevolatia amœna* Le Conte.
 474. *Brachycephus subpunctatus* Le Conte.
 475. *cribrarius* Le Conte.
 476. *perforatus* Schaum.
 477. *Seydmannus flavitarsis* Le Conte.
 478. *fossiger* Le Conte.
 479. *capillosulus* Le Conte.
 480. *basalis* Le Conte.
 481. *hirtellus* Le Conte.
 482. *analis* Le Conte.
 483. *brevicornis* Say.
 484. *rasus* Le Conte.
 485. *obscurellus* Le Conte.
 486. *clavatus* Le Conte.
 487. *clavipes* Say.
 488. *consobrinus* Le Conte.
 489. *lecontei* Schauffuss.
 490. *salinator* Le Conte.
 491. *fatuus* Le Conte.
 492. *misellus* Le Conte.
 493. *fulvus* Le Conte.
 494. *pyramidalis* Le Conte.
 495. *Eunierus grossus* Le Conte.
 496. *rotschulskii* Le Conte.
 497. *Cholerus zimmermanni* Schaum.
 498. *Cephennium corporosum* Le Conte.

PSELAPHID.E.

499. *Adranes lecontei* Brendel.
 500. *Ceophyllus monilis* Le Conte.
 501. *Celius ziegleri* Le Conte.
 502. *spinosus* Le Conte.
 503. *Tmesiphorus costalis* Le Conte.
 504. *carinatus* Le Conte.
 505. *Chemium monilicornæ* Brendel.
 506. *Ctenistes piccus* Le Conte.
 507. *consobrinus* Le Conte.
 508. *zimmermanni* Le Conte.
 509. *Tyrus humeralis* Aubé.
 510. *Pselaphus erichsonii* Le Conte.
 511. *Tychus longipalpus* Le Conte.
 512. *minor* Le Conte.
 513. *Eutrichites zimmermanni* Le Conte.
 514. *Nisaxis tomentosa* Aubé.
 515. *Decarthron abnorme* Le Conte.
 516. *cæcetum* Brendel.

LIST OF SPECIES—Continued.

517. *Decarthron stignosum* Brendel.
 518. *longulum* Brendel.
 519. *formiceti* Le Conte.
 520. *Bryaxis valida* Brendel.
 521. *conjuncta* Le Conte.
 522. *luniger* Le Conte.
 523. *caricornis* Brendel.
 524. *abdominalis* Aubé.
 525. *floridana* Brendel.
 526. *intermedia* Brendel.
 527. *ulkei* Brendel.
 528. *illinoensis* Brendel.
 529. *dentata* Say.
 530. *perforata* Brendel.
 531. *belfragei* Le Conte.
 532. *gemmifer* Le Conte.
 533. *atlantica* Brendel.
 534. *congener* Brendel.
 535. *rubicunda* Aubé.
 536. *puncticollis* Le Conte.
 537. *Arthmus globicollis* Le Conte.
 538. *Batriscus ionæ* Le Conte.
 539. *ferox* Le Conte.
 540. *monstruosus* Le Conte.
 541. *schaumii* Aubé.
 542. *riparius* Aubé.
 543. *scabriceps* Le Conte.
 544. *bistriatus* Le Conte.
 545. *globosus* Le Conte.
 546. *spretus* Le Conte.
 547. *putrefrons* Casey.
 548. *denticollis* Casey.
 549. *triangulifer* Brendel.
 550. *nigricans* Le Conte.
 551. *Trimium globifer* Le Conte.
 552. *impunctatum* Brendel.
 553. *discolor* Le Conte.
 554. *parvulum* Le Conte.
 555. *convexulum* Le Conte.
 556. *dubium* Le Conte.
 557. *simplex* Le Conte.
 558. *Rhexidius emalliculatus* Le Conte.
 559. *Rhexius insculptus* Le Conte.
 560. *Thesium cavifrons* Le Conte.
 561. *Trinioplectus arcuatus* Le Conte.
 562. *Euplectus leviceps* Casey.
 563. *interruptus* Le Conte.
 564. *difficilis* Le Conte.
 565. *congener* Casey.
 566. *linearis* Le Conte.
 567. *Euplectus confluens* Le Conte.
 568. *pertenuis* Casey.
 569. *Eutyphlus similis* Le Conte.
- STAPHYLINIDÆ.
570. *Allochara*¹ *lata* Gravenhorst.
 571. *brachyptera* Fourcroy.
 572. *bimaculata* Gravenhorst.
 573. *nitida* Gravenhorst.
 574. *Cyrtarca suturalis* Mannerheim.
 575. *Oxygoda*² *sagulata* Erichson.
 576. *minuta* Sachse.
 577. *Ocyusa asperula* Casey.
 578. *Thiasophila angustiventris* Casey.
 579. *Ocealea* sp.
 580. *Phlacopora latens* Erichson.
 581. *Xenodusa cura* Le Conte.
 582. *Mymedonia rudis* Le Conte.
 583. *planifera* Casey.
 584. *loricata* Casey.
 585. *caliginosa* Casey.
 586. *schwarzi* Wasmann.
 587. *Philothermes pennsylvanicus* Kraatz.
 588. *pilosus* Kraatz.
 589. *Callicerus*, two species.
 590. *Hoplautria*² *lateralis* Melsheimer.
 591. *Trichiusa*² *compacta* Casey.
 592. *Atheta*³ *æmula* Erichson.
 593. *dichroa* Gravenhorst.
 594. *luteola* Erichson.
 595. *recondita* Erichson.
 596. *analis* Gravenhorst.
 597. *lividipennis* Mannerheim.
 598. *Tachypusa gracillima* Le Conte.
 599. *nigrella* Le Conte.
 600. *baltifera* Le Conte.
 601. *Falagria bilobata* Say.
 602. *cingulata* Le Conte.
 603. *dissecta* Erichson.
 604. *quadriceps* Le Conte.
 605. *venustula* Erichson.
 606. *Bolitochara trimaculata* Erichson.
 607. *Myrmecochara debilis* Wasmann.
 608. *Euryusa obtusa* Le Conte.
 609. *Leptusa*² *opaca* Casey.
 610. *Silusa*.⁴
 611. *Homalota plana* Gyllenhal.
 612. *Placusa*.²
 613. *Gyrophana*⁵ *vinula* Erichson.
 614. *flavicornis* Melsheimer.

¹ One species undetermined.² Several undetermined species.³ Many undetermined species.⁴ Three undetermined species.⁵ About eight undetermined species.

LIST OF SPECIES—Continued.

615. <i>Gyrophaena corruscula</i> Erichson.	662. <i>Philonthus cunctans</i> Horn.
616. <i>Oligota</i> ¹ <i>pedalis</i> Le Conte.	663. <i>equalis</i> Horn.
617. <i>Myllæna</i> ² <i>infusca</i> Kraatz.	664. <i>brunneus</i> Gravenhorst.
618. <i>Dinopsis americanus</i> Kraatz.	665. <i>cyanipectus</i> Fabricius.
619. <i>myllænoides</i> Kraatz. ³	666. <i>blandus</i> Gravenhorst.
620. <i>Acylophorus flavicollis</i> Sachse.	667. <i>cephalotes</i> Gravenhorst.
621. <i>pronus</i> Erichson.	668. <i>inquietus</i> Erichson.
622. <i>densus</i> Le Conte.	669. <i>ventralis</i> Gravenhorst.
623. <i>Heterothops pusio</i> Le Conte.	670. <i>microphthalmus</i> Horn.
624. <i>Quedius ferox</i> Le Conte.	671. <i>baltimorensis</i> Graven-
625. <i>fulgidus</i> Fabricius.	horst.
626. <i>peregrinus</i> Gravenhorst.	672. <i>apicalis</i> Say.
627. <i>capucinus</i> Gravenhorst.	673. <i>Actobius cinerascens</i> Gravenhorst.
628. <i>molechinus</i> Gravenhorst.	674. <i>procerulus</i> Gravenhorst.
629. <i>Listrotroplus cingulatus</i> Gravenhorst.	675. <i>sobrinus</i> Erichson.
630. <i>Creophilus villosus</i> Gravenhorst.	676. <i>patella</i> Horn.
631. <i>Staphylinus vulpinus</i> Nordmann.	677. <i>loxatus</i> Horn.
632. <i>maculosus</i> Gravenhorst.	678. <i>parvus</i> Horn.
633. <i>mysticus</i> Erichson.	679. <i>paederoïdes</i> Horn.
634. <i>tomentosus</i> Gravenhorst.	680. <i>jocosus</i> Horn.
635. <i>fossator</i> Gravenhorst.	681. <i>terminalis</i> Le Conte.
636. <i>comes</i> Le Conte.	682. <i>lepidulus</i> Le Conte.
637. <i>cinnamopterus</i> Graven-	683. <i>Xantholinus fulgidus</i> Fabricius.
horst.	684. <i>cephalus</i> Say.
638. <i>violaceus</i> Gravenhorst.	685. <i>obsidianus</i> Melsheimer.
639. <i>viridans</i> Horn.	686. <i>emmesus</i> Gravenhorst.
640. <i>exulans</i> Erichson.	687. <i>hamatus</i> Say.
641. <i>prælongus</i> Mannerheim.	688. <i>temporalis</i> Le Conte.
642. <i>Ocyptus ater</i> Gravenhorst.	689. <i>Leptolinus rubripennis</i> Le Conte.
643. <i>Belonuchus formosus</i> Gravenhorst.	690. <i>Leptacinus longicollis</i> Le Conte.
644. <i>Tympanophorus puncticollis</i> Erichson.	691. <i>nigritulus</i> Le Conte.
645. <i>Philonthus politus</i> Linneus.	692. <i>cephalicus</i> Le Conte.
646. <i>unbratilis</i> Gravenhorst.	693. <i>Diochus schaumii</i> Kraatz.
647. <i>lelulus</i> Say.	694. <i>Stenus bipunctatus</i> Erichson.
648. <i>asper</i> Horn.	695. <i>colon</i> Say.
649. <i>hepaticus</i> Erichson.	696. <i>semicolon</i> Le Conte.
650. <i>umbrinus</i> Gravenhorst.	697. <i>delawarensis</i> Casey.
651. <i>pallidus</i> Gravenhorst.	698. <i>militaris</i> Casey.
652. <i>debilis</i> Gravenhorst.	699. <i>coloratus</i> Erichson.
653. <i>varians</i> Paykull.	700. <i>stygius</i> Say.
654. <i>longicornis</i> Stephens.	701. <i>egens</i> Erichson.
655. <i>discoïdeus</i> Gravenhorst.	702. <i>sectilifer</i> Casey.
656. <i>thermarum</i> Aubé.	703. <i>carolinæ</i> Casey.
657. <i>alumnus</i> Erichson.	704. <i>argus</i> Gravenhorst.
658. <i>thoracicus</i> Gravenhorst.	705. <i>dispar</i> Casey.
659. <i>fusiformis</i> Melsheimer.	706. <i>croceatus</i> Casey.
660. <i>fulvipes</i> Fabricius.	707. <i>flavicornis</i> Erichson.
661. <i>lomatius</i> Erichson.	708. <i>annularis</i> Erichson.

¹ Several undetermined species.² Several species.³ A large number of species belonging to different genera of the subfamily Aleocharinæ still remain undetermined.

LIST OF SPECIES—Continued.

709. <i>Stenus collosus</i> Erichson.	759. <i>Tachinus memnonius</i> Gravenhorst.
710. <i>arculus</i> Erichson.	760. <i>lividus</i> Erichson.
711. <i>punctatus</i> Erichson.	761. <i>flavipennis</i> Dejean.
712. <i>Eucyrtus americanus</i> Erichson.	762. <i>repandus</i> Horn.
713. <i>Edaphus nitidus</i> Le Conte.	763. <i>fibriatus</i> Gravenhorst.
714. <i>Stictocranius puncticeps</i> Le Conte.	764. <i>picipes</i> Erichson.
715. <i>Cryptobium badium</i> Gravenhorst.	765. <i>limbatus</i> Melsheimer.
716. <i>bicolor</i> Gravenhorst.	766. <i>funipennis</i> Say.
717. <i>carolinum</i> Erichson.	767. <i>nitiduloides</i> Horn.
718. <i>pallipes</i> Gravenhorst.	768. <i>pallipes</i> Gravenhorst.
719. <i>latebricola</i> Nordmann.	769. <i>Tachyporus maculipennis</i> Le Conte.
720. <i>flavicorne</i> Le Conte.	770. <i>elegans</i> Horn.
721. <i>cribratum</i> Le Conte.	771. <i>jocosus</i> Say.
722. <i>serpentinum</i> Le Conte.	772. <i>chrysomelinus</i> Linnaeus.
723. <i>Lathrobium terminatum</i> Gravenhorst.	773. <i>nitidulus</i> Fabricius.
724. <i>angulare</i> Le Conte.	774. <i>nanus</i> Erichson.
725. <i>armatum</i> Say.	775. <i>Cilea silphoides</i> Linnaeus.
726. <i>simile</i> Le Conte.	776. <i>Erchonus ventriculus</i> Say.
727. <i>longiusculum</i> Gravenhorst.	777. <i>levis</i> Le Conte.
728. <i>collare</i> Erichson.	778. <i>Conosoma knoxii</i> Le Conte.
729. <i>ambiguum</i> Le Conte.	779. <i>crassum</i> Gravenhorst.
730. <i>ventrale</i> Le Conte.	780. <i>parvum</i> Horn.
731. <i>anale</i> Le Conte.	781. <i>basale</i> Erichson.
732. <i>pallidulum</i> Le Conte.	782. <i>opicum</i> Say.
733. <i>dimidiatum</i> Say.	783. <i>scriptum</i> Horn.
734. <i>Scopaeus exiguus</i> Erichson.	784. <i>Bolitobius niger</i> Gravenhorst.
735. <i>opacus</i> Le Conte.	785. <i>dimidiatus</i> Erichson.
736. <i>nitidus</i> Le Conte.	786. <i>intrusus</i> Horn.
737. <i>Stilicus tristis</i> Melsheimer.	787. <i>cineticollis</i> Say.
738. <i>opaculus</i> Le Conte.	788. <i>auticus</i> Horn.
739. <i>angularis</i> Le Conte.	789. <i>angularis</i> Sachse.
740. <i>dentatus</i> Say.	790. <i>trinoctatus</i> Erichson.
741. <i>biarmatus</i> Le Conte.	791. <i>obsoletus</i> Say.
742. <i>rudis</i> Le Conte.	792. <i>cinctus</i> Gravenhorst.
743. <i>Lithocharis¹ ochracea</i> Gravenhorst.	793. var. <i>gentilis</i> Le Conte.
744. <i>Aderocharis corticina</i> Gravenhorst.	794. <i>Bryoporus flavipes</i> Le Conte.
745. <i>Trachysectus confusus</i> Say.	795. <i>rufescens</i> Le Conte.
746. <i>Pæderus littorarius</i> Gravenhorst.	796. <i>Mycetoporus humidus</i> Say.
747. <i>Sunius prolixus</i> Erichson.	797. <i>tenuis</i> Horn.
748. <i>binotatus</i> Say.	798. <i>consors</i> Le Conte.
749. <i>longiusculus</i> Mannerheim.	799. <i>americanus</i> Erichson.
750. <i>Echiaster brevicornis</i> Casey.	800. <i>flavicollis</i> Le Conte.
751. <i>Stilicopsis monstrosa</i> Le Conte.	801. <i>splendidus</i> Gravenhorst.
752. <i>paradoxa</i> Sachse.	802. <i>Pseudopsis sulcata</i> Newman.
753. <i>Pinophilus picipes</i> Erichson.	803. <i>Megalops cælatus</i> Gravenhorst.
754. <i>latipes</i> Erichson.	804. <i>Oxyporus femoralis</i> Gravenhorst.
755. <i>opacus</i> Le Conte.	805. <i>major</i> Gravenhorst.
756. <i>Palaminus testaceus</i> Erichson.	806. <i>stygius</i> Say.
757. <i>contortus</i> Le Conte.	807. <i>rufipennis</i> Le Conte.
758. <i>Microcyptus testaceus</i> Le Conte.	808. <i>vittatus</i> Gravenhorst.
	809. <i>fasciatus</i> Melsheimer.

¹ About five other unnamed species.

LIST OF SPECIES—Continued.

810. *Oxyporus bicolor* Fauvel.
 811. *lateralis* Gravenhorst.
 812. *occipitalis* Fauvel.
 813. *lepidus* Le Conte.
 814. *5-maculatus* Le Conte.
 815. *Oserius latipes* Erichson.
 816. *Holotrochus leucicauda* Le Conte.
 817. *Bledius mandibularis* Erichson.
 818. *semiferruginus* Le Conte.
 819. *analis* Le Conte.
 820. *sinuatus* Le Conte.
 821. *annularis* Le Conte.
 822. *confusus* Le Conte.
 823. *emarginatus* Say.
 824. *Platystethus americanus* Erichson.
 825. *Argelus incolumnis* Erichson.
 826. *sculptus* Gravenhorst.
 827. *pennsylvanicus* Erichson.
 828. *luqueatus* Marsham.
 829. *insignitus* Gravenhorst.
 830. *suspectus* Casey.
 831. *placensinus* Le Conte.
 832. *nanus* Erichson.
 833. *exiguus* Erichson.
 834. *Trogophilicus quadripunctatus* Say.
 835. *arcifer* Le Conte.
 836. *memnonius* Erichson.
 837. *corvinus* Casey.
 838. *fulvipes* Erichson.
 839. *subtilis* Erichson.
 840. *uniformis* Le Conte.
 841. *spretus* Casey.
 842. *difficilis* Casey.
 843. *riparius* Lacordaire.
 844. *fuliginosus* Gravenhorst.
 845. *pusillus* Gravenhorst.
 846. *tenellus* Erichson.
 847. *Apocellus sphaericollis* Erichson.
 848. *Ancyrophorus*.¹
 849. *Thinobius fimbriatus* Le Conte.
 850. *Geodromicus casus* Erichson.
 851. *nigrita* Müller.
 852. *Lestera pallipes* Le Conte.
 853. *Acidota subcarinata* Erichson.
 854. *Arpedium schwarzi* Fauvel.
 855. *Olophrum obtectum* Erichson.
 856. *Homalium*² *humerosum* Fauvel.
 857. *repandum* Erichson.
 858. *cribrum* Fauvel.
 859. *diffusum* Fauvel.
 860. *rufipes* Fourcroy.
 861. *Homalium fractum* Fauvel.
 862. *humatum* Fauvel.
 863. *Anthobium convexum* Fauvel.
 864. *Ephelis notata* Le Conte.
 865. *guttata* Le Conte.
 866. *Protinus atomarius* Erichson.
 867. *Megarthrus americanus* Sachse.
 868. *Lispinus exiguus* Erichson.
 869. *Glyptoma costale* Erichson.
 870. *Triga picipennis* Le Conte.
 871. *Eleusis pallida* Le Conte.
 872. *nigrella* Le Conte.
 873. *Siagonium americanum* Melsheimer.
 874. *Micropeplus cribratus* Le Conte.
- TRICHOPTERYGIDÆ.*
875. *Nossidium americanum* Motschulsky.
 876. *Ptilium collani* Macklin.
 877. *Ptenidium foreivolle* Le Conte.
 878. *speculifer* Matthews.
 879. *evanesceus* Marsham.
 880. *lineatum* Le Conte.
 881. *Limulodes paradoxus* Matthews.
 882. *Pteryx balleata* Le Conte.
 883. *Ptinellodes lecontei* Matthews.
 884. *Trichopteryx*³ *parallela* Motschulsky.
 885. *haldemani* Le Conte.
 886. *abrupta* Haldeman.
 887. *aspera* Haldeman.
 888. *marens* Matthews.
 889. *sericans* Heer.
 890. *glabricollis* Matthews.
 891. *Smicrus filicornis* Fairmaire.
 892. *Ptinella quercus* Le Conte.
 893. *pini* Le Conte.
 894. *Nephanes laeviusculus* Matthews.
- SCAPHIDIDÆ.*
895. *Scaphidium obliteratum* Le Conte.
 896. *quadriguttatum* Say.
 897. var. *piccum* Melsheimer.
 898. *Cyparium flavipes* Le Conte.
 899. *Brocera concolor* Fabricius.
 900. *apicalis* Le Conte.
 901. *Toxidium gammaroides* Le Conte.
 902. *Scaphisoma convexum* Say.
 903. *punctulatum* Le Conte.
 904. *suturale* Le Conte.
 905. *terminatum* Melsheimer.
 906. *pusillum* Le Conte.

¹ Undescribed species. ² And several undescribed species. ³ Several undescribed species.

LIST OF SPECIES—Continued.

	<i>PHALACRIDÆ.</i>	952.	<i>Brachycantha dentipes</i> Fabricius.
907.	<i>Phalacrus penicillatus</i> Say.	953.	<i>ursina</i> Fabricius.
908.	<i>politus</i> Melsheimer.	954.	var. <i>flavifrons</i> Mulsant.
909.	<i>pumilio</i> Le Conte.	955.	var. <i>10-pustulata</i> Melsheimer.
910.	<i>Olibrus lecontei</i> Casey.		var. <i>basalis</i> Melsheimer.
911.	<i>piceus</i> Casey.	956.	var. <i>basalis</i> Melsheimer.
912.	<i>striatulus</i> Le Conte.	957.	<i>4-punctata</i> Melsheimer.
913.	<i>consimilis</i> Melsheimer.	958.	<i>indubitabilis</i> Crotch.
914.	<i>nitidus</i> Melsheimer.	959.	<i>Hyperaspis fimbriolata</i> Melsheimer.
915.	<i>pusillus</i> Le Conte.	960.	<i>undulata</i> Say.
916.	<i>Litochrus immaculatus</i> Casey.	961.	<i>lewisii</i> Crotch.
917.	<i>Litochropus sculptus</i> Casey.	962.	<i>signata</i> Olivier.
	<i>CORYLOPHIDÆ.</i>	963.	<i>proba</i> Say.
918.	<i>Sacium fasciatum</i> Say.	964.	<i>bigeninata</i> Randall.
919.	<i>lepidum</i> Le Conte.	965.	<i>pratensis</i> Le Conte.
920.	<i>lunatum</i> Le Conte.	966.	<i>Sejuncus nigrividuus</i> Mulsant.
921.	<i>misellum</i> Le Conte.	967.	<i>quadritunicatus</i> Le Conte.
922.	<i>splendens</i> Schwarz.	968.	<i>xanthaspis</i> Mulsant.
923.	<i>scitulum</i> Le Conte.	968.	<i>terminatus</i> Say.
924.	<i>Arthrolips marginicollis</i> Le Conte.	970.	<i>intrusus</i> Horn.
925.	<i>Corylophus truncatus</i> Le Conte.	971.	<i>flavifrons</i> Melsheimer.
926.	<i>Sericoderus flavulus</i> Le Conte.	972.	var. <i>bioculatus</i> Mulsant.
927.	<i>obscurus</i> Le Conte.	973.	<i>americanus</i> Mulsant.
928.	<i>subtilis</i> Le Conte.	974.	<i>fraternus</i> Le Conte.
929.	<i>Orthoperus glaber</i> Le Conte.	975.	<i>collaris</i> Melsheimer.
	<i>COCCINELLIDÆ.</i>	976.	<i>cervicalis</i> Mulsant.
930.	<i>Anisosticta seriata</i> Melsheimer.	977.	<i>tenebrosus</i> Mulsant.
931.	<i>Megilla maculata</i> De Geer.	978.	<i>punctum</i> Le Conte.
932.	<i>Hippodamia glacialis</i> Fabricius.	979.	<i>nanus</i> Le Conte.
933.	<i>convergens</i> Guérin.	980.	<i>punctatus</i> Melsheimer.
934.	<i>13-punctata</i> Linnaeus.	981.	<i>Cephalosejuncus zimmermanni</i> Crotch.
935.	<i>parenthesis</i> Say.	982.	<i>Epilachna borealis</i> Fabricius.
936.	<i>Coccinella affinis</i> Randall.		<i>ENDOMYCHIDÆ.</i>
937.	<i>9-notata</i> Herbst.	983.	<i>Alexia lobata</i> Le Conte.
938.	<i>sanguinea</i> Linnaeus.	984.	<i>Ananorplus pusillus</i> Zimmermann.
939.	<i>oculata</i> Fabricius.	985.	<i>Symbiotes ulkei</i> Crotch.
940.	var. <i>abdominalis</i> Say.	986.	<i>minor</i> Crotch.
941.	<i>Adalia bipunctata</i> Linnaeus.	987.	<i>Myctæa hirta</i> Marsham.
942.	<i>Harmonia picta</i> Randall.	988.	<i>Rhanis unicolor</i> Ziegler.
943.	<i>Mysia pullata</i> Say.	989.	<i>Liestes</i> . ¹
944.	<i>Anatis ocellata</i> Linnaeus.	990.	<i>Phymaphora pulchella</i> Newman.
945.	<i>Psyllobora 20-maculata</i> Say.	991.	<i>Lycoperdina ferruginea</i> Le Conte.
946.	<i>Chilocorus biruberus</i> Mulsant.	992.	<i>Aphorista vittata</i> Fabricius.
947.	<i>Ecochomus marginipennis</i> Le Conte.	993.	<i>Myctina testacea</i> Fabricius.
948.	<i>3-pustulatus</i> De Geer.	994.	<i>perpulchra</i> Newman.
949.	<i>Cryptognatha pusilla</i> Le Conte.	995.	<i>Stenotarsus hispidus</i> Herbst.
950.	<i>Smilia marginata</i> Le Conte.	996.	<i>Endomychus biguttatus</i> Say.
951.	<i>misella</i> Le Conte.		

¹Species not described.

LIST OF SPECIES—Continued.

EROTYLIDÆ.

997. *Languria bicolor* Fabricius.
 998. *mozardi* Latreille.
 999. *angustata* Beauvois.
 1000. var. *trifasciata* Say.
 1001. *lecontei* Crotch.
 1002. *Acropteroxys gracilis* Newman.
 1003. *Eurexetus punctatus* Le Conte.
 1004. *Dacne 4-maculata* Say.
 1005. *Megalodacne fuscata* Fabricius.
 1006. *heros* Say.
 1007. *Ischyrys 4-punctatus* Olivier.
 1008. *Mycotretus sanguinipennis* Say.
 1009. *pulchra* Say.
 1010. *Tritoma humeralis* Fabricius.
 1011. var. *aulica* Horn.
 1012. *biguttata* Say.
 1013. *mimetica* Crotch.
 1014. *erythrocephala* Lacordaire.
 1015. *angulata* Say.
 1016. *affinis* Lacordaire.
 1017. *unicolor* Say.
 1018. *thoracica* Say.
 1019. *flavicollis* Lacordaire.
- COLYDIIDÆ.
1020. *Syncheta laticollis* Le Conte.
 1021. *obscura* Horn.
 1022. *parvula* Guérin.
 1023. *fuliginosa* Melsheimer.
 1024. *granulata* Say.
 1025. *Cicones marginalis* Melsheimer.
 1026. *Ditoma quadriguttata* Say.
 1027. *quadricollis* Horn.
 1028. *Coxelus guttulatus* Le Conte.
 1029. *Lasconotus referendarius* Zimmermann.
 1030. *Aulonium parallelopedum* Say.
 1031. *tuberculatum* Le Conte.
 1032. *Colydium lineola* Say.
 1033. var. *nigripennis* Le Conte.
 1034. *Aglenus brunneus* Gyllenhal.
 1035. *Oxytremus americanus* Le Conte.
 1036. *Penthelispa hamatodes* Fabricius.
 1037. *reflexa* Say.
 1038. *Pycnomerus suleicollis* Le Conte.
 1039. *Bothrideres geminatus* Say.
 1040. *Erotylathris exaratus* Melsheimer.
 1041. *Cerylon castaneum* Say.
 1042. *Philothermus glabriculus* Le Conte.

MURMIDIIDÆ.

1043. *Murmidius oralis* Beck.
 1044. *Mychocerus depressus* Le Conte.

RHYSSODIDÆ.

1045. *Rhyssodes exaratus* Illiger.
 1046. *Clinidium sculptile* Newman.

CUCUJIDÆ.

1047. *Silvanus surinamensis* Linnaeus.
 1048. *bidentatus* Fabricius.
 1049. *planatus* Germar.
 1050. *imbellis* Le Conte.
 1051. *advena* Waltl.
 1052. *rectus* Le Conte.
 1053. *Nausibius clavicornis* Kugelann.
 1054. *repandus* Le Conte.
 1055. *Catogenus rufus* Fabricius.
 1056. *Pediacus depressus* Herbst.
 1057. *Cucujus clavipes* Fabricius.
 1058. *Ino reclusa* Le Conte.
 1059. *Læmophlarus biguttatus* Say.
 1060. *fasciatus* Melsheimer.
 1061. *modestus* Say.
 1062. *convexus* Le Conte.
 1063. *adustus* Le Conte.
 1064. *testaceus* Fabricius.
 1065. *punctatus* Le Conte.
 1066. *angustulus* Le Conte.
 1067. *schwarzi* Casey.
 1068. *alternans* Erichson.
 1069. *pusillus* Schönherr.
 1070. *Lathropus vernalis* Le Conte.
 1071. *Dysmerus basalis* Casey.
 1072. *Brontes dubius* Fabricius.
 1073. *debilis* Le Conte.
 1074. *Telephanus velox* Haldeman.

CRYPTOPHAGIDÆ.

1075. *Telmatoptilus americanus* Le Conte.
 1076. *Loberus impressus* Le Conte.
 1077. *Tomarus pulchellus* Le Conte.
 1078. *Anthrophagus ochraceus* Melsheimer.
 1079. *Henoticus serratus* Gyllenhal.
 1080. *Cryptophagus*¹ *cellaris* Scopuli.
 1081. *difficilis* Le Conte.
 1082. *pectrum* Casey.

¹And several unnamed species.

LIST OF SPECIES—Continued.

1083.	<i>Cryptophagus croceus</i> Zimmermann.	1122.	<i>Anthrenus scrophulariæ</i> Linnaeus.
		1123.	<i>verbasci</i> Linnaeus.
1084.	<i>fungicola</i> Zimmermann.	1124.	<i>muscorum</i> Linnaeus.
1085.	<i>crinitus</i> Zimmermann.	1125.	<i>Cryptorhopalum hæmorrhoidale</i> Le Conte.
1086.	<i>nodangulus</i> Zimmermann.	1126.	<i>triste</i> Le Conte.
1087.	<i>Cvnoocelis</i> ¹ <i>ferruginea</i> Sahlberg(?).	1127.	<i>Apsectus hispidus</i> Melsheimer.
1088.	<i>testacea</i> Zimmermann.	1128.*	<i>Orphilus niger</i> Rossi.
1089.	<i>Atomaria</i> ¹ <i>cphippiata</i> Zimmermann.		<i>HISTERIDÆ.</i>
1090.	<i>ochracea</i> Zimmermann.	1129.	<i>Hololepta lucida</i> Le Conte.
1091.	<i>distincta</i> Casey.	1130.	<i>fossularis</i> Say.
1092.	<i>Ephistenus apicalis</i> Le Conte.	1131.	<i>Hister biplagiatus</i> Le Conte.
	<i>MYCETOPHAGIDÆ.</i>	1132.	<i>lævipès</i> Germar.
1093.	<i>Mycetophagus punctatus</i> Say.	1133.	<i>harrisii</i> Kirby.
1094.	<i>flexuosus</i> Say.	1134.	<i>merdarius</i> Hoffmann.
1095.	<i>bipustulatus</i> Melsheimer.	1135.	<i>interruptus</i> Beauvois.
1096.	<i>melsheimeri</i> Le Conte.	1136.	<i>immunis</i> Erichson.
1097.	<i>pluripunctatus</i> Le Conte.	1137.	<i>marginicollis</i> Le Conte.
1098.	<i>pini</i> Ziegler.	1138.	<i>cognatus</i> Le Conte.
1099.	<i>obsoletus</i> Melsheimer.	1139.	<i>fedatus</i> Le Conte.
1100.	<i>Litargus tetraspilotus</i> Le Conte.	1140.	<i>abbreviatus</i> Fabricius.
1101.	<i>6-punctatus</i> Say.	1141.	<i>civilis</i> Le Conte.
1102.	<i>balticus</i> Le Conte.	1142.	<i>depurator</i> Say.
1103.	<i>didesmus</i> Say.	1143.	<i>curtatus</i> Le Conte.
1104.	<i>nebulosus</i> Le Conte.	1144.	<i>indistinctus</i> Say.
1105.	<i>Typhaea fumata</i> Linnaeus.	1145.	<i>bimaculatus</i> Linnaeus.
1106.	<i>Berginus puntilus</i> Le Conte.	1146.	<i>16-striatus</i> Say.
1107.	<i>Myrmecohivens lathridioides</i> Crotch.	1147.	<i>americanus</i> Paykull.
1108.	<i>Diplocatus brunneus</i> Le Conte.	1148.	<i>Phelister æconomicaus</i> Horn.
1109.	<i>rudis</i> Le Conte.	1149.	<i>subrotundus</i> Say.
	<i>DERMESTIDÆ.</i>	1150.	<i>vermis</i> Say.
1110.	<i>Byturus unicolor</i> Say.	1151.	<i>Platysoma carolinum</i> Paykull.
1111.	<i>Dermestes caninus</i> Germar.	1152.	<i>lecontei</i> Marseul.
1112.	<i>lardarius</i> Linnaeus.	1153.	<i>aurelianum</i> Horn.
1113.	<i>elongatus</i> Le Conte.	1154.	<i>parallelum</i> Say.
1114.	<i>vulpinus</i> Fabricius.	1155.	<i>coarctatum</i> Le Conte.
1115.	<i>frischii</i> Kugelann.	1156.	<i>Cylistix cylindricus</i> Paykull.
1116.	<i>Attagenus pelliø</i> Linnaeus.	1157.	<i>attenuatus</i> Le Conte.
1117.	<i>hornii</i> Jayne.	1158.	<i>Tribalister marginellus</i> Le Conte.
1118.	<i>piceus</i> Olivier.	1159.	<i>Tribalus americanus</i> Le Conte.
1119.	<i>Trogoderma ornatum</i> Say.	1160.	<i>Epierus regularis</i> Beauvois.
1120.	<i>sternale</i> Jayne.	1161.	<i>pulicarius</i> Erichson.
1121.	<i>tarsale</i> Melsheimer.	1162.	<i>Heterius brunneipennis</i> Randall.
		1163.	<i>Echinodes setiger</i> Le Conte.
		1164.	<i>Onthophilus alternatus</i> Say.
		1165.	<i>Dendrophilus punctulatus</i> Say.
		1166.	<i>Paromabius aqualis</i> Say.
		1167.	<i>bistriatus</i> Erichson.
		1168.	<i>seminulum</i> Erichson.
		1169.	<i>teece</i> Le Conte.

¹And several unnamed species.

LIST OF SPECIES—Continued.

1170. *Carcinops conjunctus* Say.
 1171. *geminatus* Le Conte.
 1172. *14-striatus* Stephens.
 1173. *Anapleus marginatus* Le Conte.
 1174. *Suprinus rotundatus* Kugelann.
 1175. *pennsylvanicus* Paykull.
 1176. *impressus* Le Conte.
 1177. *assimilis* Paykull.
 1178. *conformis* Le Conte.
 1179. *placidus* Erichson.
 1180. *fraternus* Say.
 1181. *fitchii* Marseul.
 1182. *patruelis* Le Conte.
 1183. *sphaeroides* Le Conte.
 1184. *Plegaderus transversus* Say.
 1185. *Teretrius americanus* Le Conte.
 1186. *Bucanius tantillus* Le Conte.
 1187. *punctiformis* Marseul.
 1188. *Acrilus criguis* Erichson.
 1189. *discus* Le Conte.
 1190. *fimetarius* Le Conte.
 1191. *strigosus* Le Conte.
 1192. *politus* Le Conte.
 1193. *simplex* Le Conte.
- NITIDULIDÆ.
1194. *Brachypterus urticae* Fabricius.
 1195. *Cercus abdominalis* Erichson.
 1196. *pennatus* Murray.
 1197. *Carpophilus hemipterus* Linnaeus.
 1198. *dimidiatus* Fabricius.
 1199. *niger* Say.
 1200. *marginatus* Erichson.
 1201. *corticinus* Erichson.
 1202. *brachypterus* Say.
 1203. *antiquus* Melsheimer.
 1204. *Colastus morio* Erichson.
 1205. *maculatus* Erichson.
 1206. *semitectus* Say.
 1207. *unicolor* Say.
 1208. *truncatus* Randall.
 1209. *Conotelus obscurus* Erichson.
 1210. *mevicantus* Murray.
 1211. *Epuræa helvola* Erichson.
 1212. *rufa* Say.
 1213. *erichsonii* Reitter.
 1214. *rufida* Melsheimer.
 1215. *corticina* Erichson.
 1216. *fulvescens* Horn.
 1217. *planulata* Erichson.
1218. *Epuræa peltoides* Horn.
 1219. *labilis* Erichson.
 1220. *obtusicollis* Reitter.
 1221. *Nitidula bipunctata* Linnaeus.
 1222. *rufipes* Linnaeus.
 1223. *ziczac* Say.
 1224. *Stelidota geminata* Say.
 1225. *8-maculata* Say.
 1226. *strigosa* Gyllenhal.
 1227. *Prometopia 6-maculata* Say.
 1228. *Phenolia grossa* Fabricius.
 1229. *Omosita colon* Linnaeus.
 1230. *Amphotis ulkei* Le Conte.
 1231. *Soronia undulata* Say.
 1232. *substriata* Hamilton.
 1233. *Thalyera concolor* Le Conte.
 1234. *Pocadius helrolus* Erichson.
 1235. *Oxyenemus histrinus* Le Conte.
 1236. *nigripennis* Le Conte.
 1237. *Amphicrossus ciliatus* Olivier.
 1238. *Pallodes pallidus* Beauvois.
 1239. *Cycharanus adustus* Erichson.
 1240. var. *bicolor* Horn.
 1241. *Cybocephalus nigritulus* Le Conte.
 1242. *Cryptarcha ampla* Erichson.
 1243. *strigata* Fabricius.
 1244. *concinna* Melsheimer.
 1245. *Ips obtusus* Say.
 1246. *quadriguttatus* Fabricius.
 1247. *confluentus* Say.
 1248. *sanguinolentus* Olivier.
 1249. *Pityophagus cephalotes* Le Conte.
 1250. *Rhizophagus cylindricus* Le Conte
 1251. *bipunctatus* Say.
- LATHRIDIDÆ.
1252. *Holoparamesus kuetzi* Aubé.
 1253. *Lathridius tiratus* Le Conte.
 1254. *Coninonius constrictus* Gyllenhal.
 1255. *nodifer* Westwood.
 1256. *Enicmus minutus* Linnaeus.
 1257. *aterrimus* Motschulsky
 1258. *Curtodere elegans* Aubé.
 1259. *jiliformis* Gyllenhal.
 1260. *Adistemia watsoni* Wollaston.
 1261. *Corticaria pubescens* Gyllenhal.
 1262. *dentigera* Le Conte.
 1263. *ferruginea* Gyllenhal.
 1264. *serrata* Paykull.
 1265. *elongata* Gyllenhal.

LIST OF SPECIES—Continued.

1266. *Melanophthalma*¹ *longipennis* Le Conte.
 1267. *americana* Mannerheim.
 1268. *cavicolis* Mannerheim.
 1269. *gibbosa* Herbst.
 1270. *distinguenda* Comoli.
 1271. *picta* Le Conte.
 1272. *simplex* Le Conte.
- TROGOSITID.E.
1273. *Nemosoma parallelum* Melsheimer.
 1274. *cylindricum* Le Conte.
 1275. *Atindria cylindrica* Serville.
 1276. *teres* Melsheimer.
 1277. *Trogosita virescens* Fabricius.
 1278. *Tenebrioides mauritanica* Linnaeus.
 1279. *corticalis* Melsheimer.
 1280. *nana* Melsheimer.
 1281. *marginata* Beauvois.
 1282. var. *cucujiformis* Horn.
 1283. *americana* Kirby.
 1284. var. *laticollis* Horn.
 1285. *rugosipennis* Horn.
 1286. *binaculata* Melsheimer.
 1287. *obtusa* Horn.
 1288. *Grynocharis 4-lineata* Melsheimer.
 1289. *Lycoptus villosus* Casey.
 1290. *Thymalus fulgidus* Erichson.
- MONOTOMID.E.
1291. *Monotoma picipes* Herbst.
 1292. *americana* Aubé.
 1293. *4-forcolata* Aubé.
 1294. *parallela* Le Conte.
 1295. *longicollis* Gyllenhal.
 1296. *Hesperobanus rufipes* Le Conte.
 1297. *Europus pullipennis* Le Conte.
 1298. *Bactridium cphippigerum* Guérin.
 1299. *striolatum* Reitter.
 1300. *cavicolle* Horn.
- BYRRHID.E.
1301. *Nosodendron unicolor* Say.
 1302. *Byrrhus aurinus* Fabricius.
 1303. *Syncolypla strigosa* Melsheimer.
1304. *Limnichus olivaceus* Le Conte.
 1305. *punctatus* Le Conte.
 1306. *nebulosus* Le Conte.
 1307. *ater* Le Conte.
 1308. *lutrochinus* Le Conte.
 1309. *oratus* Le Conte.
- PARNID.E.
1310. *Psephenus lecontei* Le Conte.
 1311. *Lutrochus luteus* Le Conte.
 1312. *Dryops lithophilus* Germar.
 1313. *fastigiatus* Say.
 1314. *Elmis 4-notatus* Say.
 1315. *fastiditus* Le Conte.
 1316. *ocalis* Le Conte.
 1317. *nitidulus* Le Conte.
 1318. *laticusculus* Le Conte.
 1319. *pusillus* Le Conte.
 1320. *Stenelmis linearis* Zimmerman.
 1321. *sinuatus* Le Conte.
 1322. *crenatus* Say.
 1323. *quadrinaculatus* Horn.
 1324. *Macronychus glabratus* Say.
 1325. *Ancyronyx variegatus* Germar.
- HETEROCERID.E.
1326. *Heterocerus ventralis* Melsheimer.
 1327. *brunneus* Melsheimer.
 1328. *collaris* Kiesenwetter.
 1329. *pusillus* Say.
- DASYLLID.E.
1330. *Eurypogon niger* Melsheimer.
 1331. *californicus* Horn.
 1332. *Odontonyx tricittis* Germar.
 1333. *Anchytarsus bicolor* Melsheimer.
 1334. *Ptilodactyla serripennis* Say.
 1335. *Eucinetus punctulatus* Le Conte.
 1336. *morio* Le Conte.
 1337. *strigosus* Le Conte.
 1338. *Ectopria nervosa* Melsheimer.
 1339. var. *thoracica* Ziegler.
 1340. *Prionocephon discoides* Say.
 1341. *limbatus* Le Conte.
 1342. *Helodes pulchella* Guérin.
 1343. *fuscipennis* Guérin.
 1344. *thoracica* Guérin.
 1345. *Scyrtes tibialis* Guérin.
 1346. *Cyphon robustus* Le Conte.

¹And some undetermined species.

LIST OF SPECIES—Continued.

1347. *Cyphon obscurus* Guérin.
 1348. *variabilis* Thunberg.
 1349. *collaris* Guérin.
 1350. *ruficollis* Say.
- RHIPICERID.E.
1351. *Zenopsis picea* Beauvois.
 1352. *Sandalus niger* Knoch.
 1353. *petrophyla* Knoch.
- ELATERID.E.
1354. *Melasis pectinicornis* Melsheimer.
 1355. *Thurops ruficornis* Say.
 1356. *Stethon pectorosus* Le Conte.
 1357. *Deltomacropus amenicornis* Say.
 1358. *rufipes* Melsheimer.
 1359. *Dromiculus striatus* Le Conte.
 1360. *cylindricollis* Say.
 1361. *Formus badius* Melsheimer.
 1362. *calceatus* Say.
 1363. *hornii* Bonvouloir.
 1364. *Adelothyrcus dejeanii* Bonvouloir.
 1365. *Microrhagus humeralis* Say.
 1366. *pectinatus* Le Conte.
 1367. *bonvouloiri* Horn.
 1368. *aulax* Horn.
 1369. *subsiniatus* Le Conte.
 1370. *triangularis* Say.
 1371. *Hypocelus frontosus* Say.
 1372. *terminalis* Le Conte.
 1373. *Nematodes atropus* Say.
 1374. *Adlocera impressicollis* Say.
 1375. *marmorata* Fabricius.
 1376. *discoidea* Weber.
 1377. *maculata* Le Conte.
 1378. *arita* Say.
 1379. *Meristhus scobinata* Candèze.
 1380. *Chalcolepidius viridipilis* Le Conte.
 1381. *Alaus ocellatus* Linnaeus.
 1382. *myops* Fabricius.
 1383. *Hemirhipus fascicularis* Fabricius.
 1384. *Cardiophorus convexus* Say.
 1385. *cardisee* Say.
 1386. *gagates* Erichson.
 1387. *Horistomotus curvatus* Say.
 1388. *Esthesopus claricollis* Say.
 1389. *Cryptohypnus choris* Say.
 1390. *melsheimeri* Horn.
 1391. *pectoralis* Say.
 1392. var. *inops* Say.
 1393. *obliquatus* Melsheimer.
1394. *Cryptohypnus perplexus* Horn.
 1395. *Anchastus rufus* Candèze.
 1396. *Monocrepidius lividus* De Geer.
 1397. *suturalis* Le Conte.
 1398. *respertinus* Fabricius.
 1399. *auritus* Herbst.
 1400. *bellus* Say.
 1401. *Dicrepidius ramicornis* Beauvois.
 1402. *Ischiodontus soleatus* Say.
 1403. *Elater hepaticus* Melsheimer.
 1404. *manipularis* Candèze.
 1405. *pedalis* Germar.
 1406. *mixtus* Herbst.
 1407. *nigricollis* Herbst.
 1408. *luteus* Say.
 1409. *discoideus* Fabricius.
 1410. *sayi* Le Conte.
 1411. *impolitus* Melsheimer.
 1412. *socer* Le Conte.
 1413. *rubricollis* Herbst.
 1414. *semicinctus* Randall.
 1415. *nigricans* Germar.
 1416. *rubricus* Say.
 1417. *collaris* Say.
 1418. var. *palans* Le Conte.
 1419. *sanguinipennis* Say.
 1420. *xanthonus* Germar.
 1421. *obliquus* Say.
 1422. *pusio* Germar.
 1423. *Drasterius elegans* Fabricius.
 1424. *anabilis* Le Conte.
 1425. *Megapenthes rufilabris* Germar.
 1426. *umbalis* Herbst.
 1427. *Ludius attenuatus* Say.
 1428. *abruptus* Say.
 1429. *Agrotes avulsus* Le Conte.
 1430. *pubescens* Melsheimer.
 1431. *insarus* Candèze.
 1432. *oblongicollis* Melsheimer.
 1433. *Dolopius lateralis* Eschscholtz.
 1434. *Beturmon bigeminatus* Randall.
 1435. *Glyphonyx reticollis* Say.
 1436. *testaceus* Melsheimer.
 1437. *Melanotus depressus* Melsheimer.
 1438. *clandestinus* Erichson.
 1439. *castanipes* Paykull.
 1440. *sagittarius* Le Conte.
 1441. *fissilis* Say.
 1442. *communis* Gyllenhal.
 1443. *infustus* Le Conte.
 1444. *tenax* Say.
 1445. *americanus* Herbst.

LIST OF SPECIES—Continued.

1446. *Melanotus pertinax* Say.
 1447. *insipiens* Say.
 1448. *Limonius auripilis* Say.
 1449. *aurifer* Le Conte.
 1450. *stigma* Herbst.
 1451. *griseus* Beauvois.
 1452. *confusus* Le Conte.
 1453. *plebejus* Say.
 1454. *quercinus* Say.
 1455. *agonus* Say.
 1456. *ornatipennis* Le Conte.
 1457. *definitus* Ziegler.
 1458. *nimbatus* Say.
 1459. *basillaris* Say.
 1460. *Athous brightwelli* Kirby.
 1461. *acanthus* Say.
 1462. *cucullatus* Say.
 1463. *scapularis* Say.
 1464. *posticus* Melsheimer.
 1465. *Leptoschema bicolor* Le Conte.
 1466. *Sericosomus viridanus* Say.
 1467. *silaceus* Say.
 1468. *Corymbites tessellatus* Linnaeus.
 1469. *cylindricornis* Herbst.
 1470. *pyrrhos* Herbst.
 1471. *tarsalis* Melsheimer.
 1472. *athlops* Herbst.
 1473. *hamatus* Say.
 1474. *splendens* Ziegler.
 1475. *inflatus* Say.
 1476. *rotundicollis* Say.
 1477. *Hemicrepidius memnonius* Herbst.
 1478. *bilobatus* Say.
 1479. *decoloratus* Say.
 1480. *Melanactes piceus* De Geer.
 1481. *morio* Fabricius.
 1482. *reichei* Germar.
 1483. *Perothops mucida* Gyllenhal.
 1484. *Cerophytum pulsator* Haldeman.
- THROSCIDÆ.**
1485. *Drapetes geminatus* Say.
 1486. *Autonothroscus constrictor* Say.
 1487. *Throscus punctatus* Bonvouloir.
 1488. *chevrolati* Bonvouloir.
 1489. *convergens* Horn.
 1490. *pugnax* Horn.
- BUPRESTIDÆ.**
1491. *Chaleophora virginianensis* Drury.
 1492. *campestris* Say.
 1493. *Dicerca divaricata* Say.
 1494. var. *caudata* Le Conte.
 1495. *pugionata* Germar.
 1496. *obscura* Fabricius.
 1497. var. *livida* Fabricius.
 1498. *lepida* Le Conte.
 1499. *spretæ* Gory.
 1500. *asperata* Laporte.
 1501. *punctulata* Schönherr.
 1502. *Pucilonota debilis* Le Conte.
 1503. *Buprestis rufipes* Olivier.
 1504. *lineata* Fabricius.
 1505. *striata* Fabricius.
 1506. *decora* Fabricius.
 1507. *Cinyra gracilipes* Melsheimer.
 1508. *Melanophila notata* Laporte.
 1509. *acuminata* De Geer.
 1510. *zoncola* Melsheimer.
 1511. *Anthaxia viridifrons* Laporte.
 1512. *viridicornis* Say.
 1513. *cyaneella* Gory.
 1514. *quercuta* Fabricius.
 1515. *fluminata* Gory.
 1516. *Chrysobothris femorata* Fabricius.
 1517. *floricola* Gory.
 1518. *dentipes* Germar.
 1519. *blanchardi* Horn.
 1520. *pusilla* Laporte.
 1521. *6-signata* Say.
 1522. *azurea* Le Conte.
 1523. *scitula* Gory.
 1524. *harrisii* Hentz.
 1525. *Actenodes acornis* Say.
 1526. *Amaoderu ornata* Fabricius.
 1527. *culta* Weber.
 1528. *Ptosima gibbicollis* Say.
 1529. *Mastogenius subcyanus* Le Conte.
 1530. *Eupristocerus cogitans* Weber.
 1531. *Agribus ruficollis* Fabricius.
 1532. *otiosus* Say.
 1533. *arcuatus* Say.
 1534. *bilineatus* Weber.
 1535. *granulatus* Say.
 1536. *politus* Say.
 1537. *fallax* Say.
 1538. *obsoletoguttatus* Gory.
 1539. *subcinctus* Gory.
 1540. *lecontei* Saunders.
 1541. *egens* Gory.
 1542. *Rhabdosecis tenuis* Le Conte.
 1543. *Taphrocerus gracilis* Say.
 1544. *Brachys orata* Weber.

LIST OF SPECIES—Continued.

1545. *Brachys xerosa* Melsheimer.
 1546. *virginosa* Gory.
 1547. *Pachyscelus purpureus* Say.
 1548. *lavigatus* Say.
- LAMPYRIDÆ.
1549. *Calopteron terminale* Say.
 1550. *reticulatum* Fabricius.
 1551. *Celetes basalis* Le Conte.
 1552. *Cenia dimidiata* Fabricius.
 1553. *Eros thoracicus* Randall.
 1554. *aurora* Herbst.
 1555. *minutus* Say.
 1556. *sculptilis* Say.
 1557. *trilineatus* Melsheimer.
 1558. *Plateros timidus* Le Conte.
 1559. *modestus* Say.
 1560. *canaliculatus* Say.
 1561. *lictor* Newman.
 1562. *floralis* Melsheimer.
 1563. *Calochromus perfactus* Say.
 1564. *Lucidota atra* Fabricius.
 1565. *punctata* Le Conte.
 1566. *Elychnia corrusca* Linnaeus.
 1567. *Pyropyga nigricans* Say.
 1568. *decipiens* Harris.
 1569. *minuta* Le Conte.
 1570. *Pyraclomena unguolata* Say.
 1571. *lucifera* Melsheimer.
 1572. *Photinus consanguineus* Le Conte.
 1573. *pyralis* Linnaeus.
 1574. *scitillans* Say.
 1575. *Photuris pennsylvanica* De Geer.
 1576. *Phengodes*.¹
 1577. *Tytlhonyx erythrocephala* Fabricius.
 1578. *Omethes marginatus* Le Conte.
 1579. *Chaulognathus pennsylvanicus* De Geer.
 1580. *marginatus* Fabricius.
 1581. *Podabrus tricosatus* Say.
 1582. *rugosulus* Le Conte.
 1583. *frater* Le Conte.
 1584. *basilaris* Say.
 1585. *tomentosus* Say.
 1586. *brunnicollis* Le Conte.
 1587. *Silis percomis* Say.
 1588. *spathulata* Le Conte.
 1589. *Ditenuus bidentatus* Say.
 1590. *Telephorus excavatus* Le Conte.
 1591. *vilis* Le Conte.
1592. *Telephorus frazini* Say.
 1593. *carolinus* Fabricius.
 1594. *lineola* Fabricius.
 1595. *costipennis* Le Conte.
 1596. *rectus* Melsheimer.
 1597. *scitulus* Say.
 1598. *pusillus* Le Conte.
 1599. *longulus* Le Conte.
 1600. *rotundicollis* Say.
 1601. *tuberculatus* Le Conte.
 1602. *bilineatus* Say.
 1603. *marginellus* Le Conte.
 1604. *Polemium laticornis* Say.
 1605. *Tryptherus latipennis* Germar.
 1606. *Malthinus occipitalis* Le Conte.
 1607. *Malthodes spudo* Le Conte.
 1608. *concarus* Le Conte.
 1609. *rectus* Le Conte.
 1610. *arcifer* Le Conte.
 1611. *captiosus* Le Conte.
 1612. *parrulus* Le Conte.
- MALACHIDÆ.
1613. *Collops tricolor* Say.
 1614. *eximius* Erichson.
 1615. *nigriceps* Say.
 1616. *4-maculatus* Fabricius.
 1617. *vittatus* Say.
 1618. *Chatocelus setosus* Le Conte.
 1619. *Anthocomus flavilabris* Say.
 1620. *Pseudochaus apicalis* Say.
 1621. *oblitus* Le Conte.
 1622. *bicolor* Le Conte.
 1623. *Attalus terminalis* Erichson.
 1624. *granularis* Erichson.
 1625. *morulus* Le Conte.
 1626. *pallifrons* Motschulsky.
 1627. *melanopterus* Erichson.
 1628. *otiosus* Say.
 1629. *circumscripatus* Say.
 1630. *scincetus* Say.
- MELYRIDÆ.
1631. *Alpimeris cribrata* Le Conte.
- CLERIDÆ.
1632. *Elasmocerus terminatus* Say.
 1633. *Cynatodera brunnea* Melsheimer.
 1634. *inornata* Say.
 1635. *undulata* Say.

¹ Unknown species, female.

LIST OF SPECIES—Continued.

1636. *Trichodes apivorus* Germar.
 1637. *Clerus quadriguttatus* Olivier.
 1638. var. *nigrifrons* Say.
 1639. *rosmearus* Say.
 1640. *ichneumoncus* Fabricius.
 1641. *thoracicus* Olivier.
 1642. *Thanasimus dubius* Fabricius.
 1643. *Thaenroclerus sanguineus* Say.
 1644. *tantillus* Le Conte.
 1645. *Hydnocera unifasciata* Say.
 1646. *humeralis* Say.
 1647. *pallipennis* Say.
 1648. *verticalis* Say.
 1649. *tabida* Le Conte.
 1650. *longicollis* Ziegler.
 1651. *Phyllobacius dislocatus* Say.
 1652. *Icanca laticornis* Say.
 1653. *Charicssa pilosa* Say.
 1654. var. *onusta* Say.
 1655. *Cregya vetusta* Spinola.
 1656. *oculata* Say.
 1657. *mixta* Le Conte.
 1658. *Orthopleura damicornis* Fabricius.
 1659. *texana* Bland.
 1660. *Necrobia rufipes* Fabricius.
 1661. *ruficollis* Fabricius.
 1662. *violacea* Linnaeus.

DERODONTID.E.

1663. *Derodontus maculatus* Melsheimer.
 1664. *Laricobius erichsoni* Rosenhauer.

PTINID.E.

1665. *Gibbium psylloides* Czenpinski.
 1666. *Ptinus fur* Linnaeus.
 1667. *brunneus* Duftschmid.
 1668. *quadrimaculatus* Melsheimer.
 1669. *interruptus* Le Conte.
 1670. *Eucrada humeralis* Melsheimer.
 1671. *Ernobius mollis* Fabricius.
 1672. *lateipennis* Le Conte.
 1673. *filicornis* Le Conte.
 1674. *granulatus* Le Conte.
 1675. *Ozognathus floridanus* Le Conte.
 1676. *Oligomerus sericans* Melsheimer.
 1677. *alternatus* Le Conte.
 1678. *obtusus* Le Conte.
 1679. *Sitodrepa panicea* Linnaeus.
 1680. *Hydrobregmus errans* Melsheimer.
 1681. *carinatus* Say.
 1682. *Trichodesma gibbosa* Say.
 1683. *Anobium notatum* Say.

1684. *Trypopytus sericeus* Say.
 1685. *Petalium bistriatum* Say.
 1686. *Theca profunda* Le Conte.
 1687. *Eupactus nitidus* Le Conte.
 1688. *Xyletinus peltatus* Harris.
 1689. *Lasioderma serricorne* Fabricius.
 1690. *Hemiptychus punctatus* Le Conte.
 1691. *gravis* Le Conte.
 1692. *ventralis* Le Conte.
 1693. *nigritulus* Le Conte.
 1694. *Protheca hispida* Le Conte.
 1695. *puberula* Le Conte.
 1696. *Dorcatoma setulosum* Le Conte.
 1697. *incomptum* Le Conte.
 1698. *palliacorne* Le Conte.
 1699. *Cænocera oculata* Say.
 1700. *intermedia* Le Conte.
 1701. *Ptilinus ruficornis* Say.
 1702. *Endecatomus rugosus* Randall.

BOSTRICHID.E.

1703. *Dimoderus minutus* Fabricius.
 1704. *Rhizopertha dominica* Fabricius.
 1705. *Stephanopachys cribratus* Le Conte.
 1706. *densus* Le Conte.
 1707. *rugosus* Olivier.
 1708. *Prostephanus punctatus* Le Conte.
 1709. *Lichenophanes truncaticollis* Le
 Conte.
 1710. *armiger* Le Conte.
 1711. *bicornis* Weber.

1712. *Schistocerus hamatus* Fabricius.
 1713. *Micrapate dinoderoides* Horn.
 1714. *cristicaula* Casey.
 1715. *Nylobiops basilaris* Say.
 1716. *texana* Horn.
 1717. *Scobicia bidentata* Horn.

LYCTID.E.

1718. *Lyctus striatus* Melsheimer.
 1719. *opaculus* Le Conte.
 1720. *planicollis* Le Conte.
 1721. *Trogoxylon parallelopipedum* Mels-
 heimer.

CUPESID.E.

1722. *Cupes concolor* Westwood.

LYMEXYLID.E.

1723. *Lymexylon sericeum* Harris.
 1724. *Micromalthus debilis* Le Conte.

LIST OF SPECIES—Continued.

	<i>CISID.E.</i>	1764. <i>Aphodius terminalis</i> Say.
		1765. <i>bicolor</i> Say.
1725. <i>Cis fuscipes</i> Mellie.		1766. <i>femoralis</i> Say.
1726. <i>creberrimus</i> Mellie.		1767. <i>oblongus</i> Say.
1727. <i>Brachycis brevicollis</i> Casey.		1768. <i>Dialytus truncatus</i> Melsheimer.
1728. <i>Orthocis punctatus</i> Mellie.		1769. <i>striatulus</i> Horn.
1729. <i>Emecarthron thoracicorne</i> Ziegler.		1770. <i>Atenius cylindrus</i> Horn.
1730. <i>Ceracis sallei</i> Mellie.		1771. <i>abditus</i> Haldeman.
1731. <i>Rhipidandrus paradoxus</i> Beauvois.		1772. <i>levontei</i> Harold.
	<i>SPHINDID.E.</i>	1773. <i>texanus</i> Harold.
		1774. <i>laviventris</i> Horn.
1732. <i>Sphindus americanus</i> Le Conte.		1775. <i>imbricatus</i> Melsheimer.
	<i>LUCANID.E.</i>	1776. <i>socialis</i> Horn.
		1777. <i>ovatus</i> Horn.
1733. <i>Lucanus elaphus</i> Fabricius.		1778. <i>gracilis</i> Melsheimer.
1734. <i>dama</i> Thunberg.		1779. <i>figurator</i> Harold.
1735. <i>Dorcus parallelus</i> Say.		1780. <i>strigatus</i> Say.
1736. <i>Platygeus quercus</i> Weber.		1781. <i>coquatus</i> Le Conte.
1737. <i>Ceruchus piceus</i> Weber.		1782. <i>Rhyssenus scaber</i> Haldeman.
1738. <i>Nicagus obscurus</i> Le Conte.		1783. <i>Pleurophorus cæsus</i> Panzer.
	<i>PASSALID.E.</i>	1784. <i>ventralis</i> Horn.
		1785. <i>Psammodiüs agidioides</i> Haldeman.
1739. <i>Passalus cornutus</i> Fabricius.		1786. <i>interruptus</i> Say.
	<i>SCARAB.EIDÆ.</i>	1787. <i>Egialia</i> new species.
		1788. <i>Ochodæus musculus</i> Say.
1740. <i>Canthon laevis</i> Drury.		1789. <i>Bolboceus furtus</i> Fabricius.
1741. <i>vigilans</i> Le Conte.		1790. <i>lazarus</i> Fabricius.
1742. <i>viridis</i> Beauvois.		1791. <i>Odontæus cornigerus</i> Melsheimer.
1743. <i>Charididion histeroides</i> Weber.		1792. <i>Grotrupes splendidus</i> Fabricius.
1744. <i>Copris carolina</i> Linnaeus.		1793. <i>balyi</i> Jekel.
1745. <i>anaglyptica</i> Say.		1794. <i>semiopacus</i> Jekel.
1746. <i>minuta</i> Drury.		1795. <i>blackburnii</i> Fabricius.
1747. <i>Phanaeus carnefex</i> Linnaeus.		1796. <i>egeriei</i> Germar.
1748. <i>Onthophagus hecate</i> Panzer.		1797. <i>hornii</i> Blanchard.
1749. <i>janus</i> Panzer.		1798. <i>Clotus aphodioides</i> Illiger.
1750. <i>var. orpheus</i> Panzer		1799. <i>Trox monachus</i> Herbst.
1751. <i>var. striatulus</i> Beauvois.		1800. <i>asper</i> Le Conte.
1752. <i>tuberculifrons</i> Harold.		1801. <i>suberosus</i> Fabricius.
1753. <i>peunylvanicus</i> Harold.		1802. <i>tuberculatus</i> De Geer.
1754. <i>Aphodius funetarius</i> Linnaeus.		1803. <i>erinaceus</i> Le Conte.
1755. <i>ruricola</i> Melsheimer.		1804. <i>capillaris</i> Say.
1756. <i>granarius</i> Linnaeus.		1805. <i>foveicollis</i> Harold.
1757. <i>rittatus</i> Say.		1806. <i>terrestris</i> Say.
1758. <i>lividus</i> Olivier.		1807. <i>scaber</i> Linnaeus.
1759. <i>serval</i> Say.		1808. <i>Hoplia trivialis</i> Harold.
1760. <i>inquinatus</i> Herbst.		1809. <i>mucorea</i> Germar.
1761. <i>leopardus</i> Horn.		1810. <i>modesta</i> Haldeman.
1762. <i>rubeolus</i> Beauvois.		1811. <i>Dichelonycha elongata</i> Fabricius.
1763. <i>stereorosus</i> Melsheimer.		1812. <i>fuscata</i> Le Conte.
		1813. <i>Serica respertina</i> Gyllenhal.
		1814. <i>iricolor</i> Say.
		1815. <i>sericea</i> Illiger.

LIST OF SPECIES—Continued.

1816. *Sericu trocifformis* Burmeister.
 1817. *Macroductylus subspinus* Fabricius.
 1818. *angustatus* Beauvois.
 1819. *Diplotaxis sordida* Say.
 1820. *liberta* Germar.
 1821. *tristis* Kirby.
 1822. *harperi* Blanchard.
 1823. *Lachnosterna prununculina* Burmeister.
 1824. *ephilida* Say.
 1825. *glaberrima* Blanchard.
 1826. *gracilis* Burmeister.
 1827. *gibbosa* Burmeister.
 1828. *congrua* Le Conte.
 1829. *inversa* Horn.
 1830. *micans* Knoch.
 1831. *fusca* Fröhlich.
 1832. *arcuata* Smith.
 1833. *grandis* Smith.
 1834. *dubia* Smith.
 1835. *hornii* Smith.
 1836. *marginalis* Le Conte.
 1837. *fraterna* Harris.
 1838. *nora* Smith.
 1839. *luctuosa* Horn.
 1840. *knochii* Gyllenhal.
 1841. *profunda* Blanchard.
 1842. *balia* Say.
 1843. *hirsuta* Knoch.
 1844. *ilicis* Knoch.
 1845. *hirticula* Knoch.
 1846. *parvidens* Le Conte.
 1847. *quercus* Knoch.
 1848. *tristis* Fabricius.
 1849. *Anomala marginata* Fabricius.
 1850. *binotata* Gyllenhal.
 1851. *undulata* Melsheimer.
 1852. *minuta* Burmeister.
 1853. *lucicola* Fabricius.
 1854. *Strigoderma arboricola* Fabricius.
 1855. *pygmaeum* Fabricius.
 1856. *Pelidnota punctata* Linnaeus.
 1857. *Cotalpa lanigera* Linnaeus.
 1858. *Cyclocephala immaculata* Burmeister.
 1859. *villosa* Burmeister.
 1860. *Chalepus trachypygus* Burmeister.
 1861. *Ligyrrus gibbosus* De Geer.
 1862. *relictus* Say.
 1863. *Aphonus tridentatus* Say.
 1864. *castaneus* Melsheimer.
 1865. *Xyloryctes satyrus* Fabricius.
 1866. *Strategus anticus* Fabricius.
 1867. *Dynastes tityus* Linnaeus.
 1868. *Phileurus valgus* Fabricius.
 1869. *Allorhina nitida* Linnaeus.
 1870. *Euphoria arcata* Fabricius.
 1871. *seputchralis* Fabricius.
 1872. *fulgida* Fabricius.
 1873. *herbacea* Olivier.
 1874. *indu* Linnaeus.
 1875. *Cremastochilus leucostictus* Burmeister.
 1876. *variolosus* Kirby.
 1877. *canaliculatus* Kirby.
 1878. *castaneae* Knoch.
 1879. *harrisii* Kirby.
 1880. *Osmoderma cremicola* Knoch.
 1881. *scabrum* Beauvois.
 1882. *Gnorimus maculosus* Knoch.
 1883. *Trichius piger* Fabricius.
 1884. *affinis* Gory.
 1885. *bibens* Fabricius.
 1886. *viridulus* Fabricius.
 1887. *Valgus canaliculatus* Fabricius.
 1888. *squamiger* Beauvois.
- SPONDYLID.E.
1889. *Parandra brunnea* Fabricius.
- CERAMBYCID.E.
1890. *Orthosoma brunneum* Forster.
 1891. *Prionus laticollis* Drury.
 1892. *popularis* Dalman.
 1893. *imbricornis* Linnaeus.
 1894. *Sphenostethus tuslei* Buquet.
 1895. *Asemmum marstoni* Haldeman.
 1896. *Criocephalus obsoletus* Randall.
 1897. *agrestis* Kirby.
 1898. *Smodicum cucujiforme* Say.
 1899. *Hylotrupes bajulus* Linnaeus.
 1900. *liqueus* Fabricius.
 1901. *Phymatodes variabilis* Fabricius.
 1902. *infuscatus* Le Conte.
 1903. *varius* Fabricius.
 1904. *amoenus* Say.
 1905. *Callidium antennatum* Newman.
 1906. *janthinatum* Le Conte.
 1907. *aeratum* Newman.
 1908. *Eme rigida* Say.
 1909. *Gracilia minuta* Fabricius.
 1910. *Chion cinctus* Drury.
 1911. *Eburia quadrigeminata* Say.

LIST OF SPECIES—Continued.

1912. *Romuleum atomarium* Drury.
 1913. *rufulum* Haldeman.
 1914. *Elaphidion unceronatum* Fabricius.
 1915. *incertum* Newman.
 1916. *villosum* Fabricius.
 1917. *pumilum* Newman.
 1918. *subpubescens* Le Conte.
 1919. *unicolor* Randall.
 1920. *cinerascens* Le Conte.
 1921. *Tylonotus bimaculatus* Haldeman.
 1922. *Heteracanthus quadrimaculatus* Newman.
 1923. *ebenus* Newman.
 1924. *Curius dentatus* Newman.
 1925. *Phyton pallidum* Say.
 1926. *Obrim rubrum* Newman.
 1927. *Callimoxys sanguinicollis* Olivier.
 1928. *Motorchius bimaculatus* Say.
 1929. *Rhopalophorus longipes* Say.
 1930. *Tragidion coquus* Linnæus.
 1931. var. *fulvipennis* Say.
 1932. *Purpuricenus humeralis* Fabricius.
 1933. var. *axillaris* Haldeman.
 1934. *Batyte suturalis* Say.
 1935. *Stenosphenus notatus* Olivier.
 1936. *Cyllene pictus* Drury.
 1937. *robinie* Forster.
 1938. *Calloides nobilis* Say.
 1939. *Archopulus fulminans* Fabricius.
 1940. *Clytus marginicollis* Laporte.
 1941. *Xylotrechus colonus* Fabricius.
 1942. *sagittatus* Germar.
 1943. *quadrimaculatus* Haldeman.
 1944. *Neoclytus scutellaris* Olivier.
 1945. *fuscus* Fabricius.
 1946. *caprea* Say.
 1947. *erythrocephalus* Fabricius.
 1948. *longipes* Kirby.
 1949. *Clytanthus ruficola* Olivier.
 1950. *albofuscatus* Laporte.
 1951. *Microclytus gazellula* Haldeman.
 1952. *Cyrtophorus verrucosus* Olivier.
 1953. *Tillomorpha geminata* Haldeman.
 1954. *Euderees picipes* Fabricius.
 1955. *pini* Olivier.
 1956. *Atimia confusa* Say.
 1957. *Distenia undata* Olivier.
 1958. *Desmoeris palliatus* Forster.
 1959. *Necydalis mellitus* Say.
 1960. *Encyclops caruleus* Say.
 1961. *Rhagium lineatum* Olivier.
 1962. *Centrodera decolorata* Harris.
 1963. *picta* Haldeman.
 1964. *Toxotus trivittatus* Say.
 1965. *Aemwops discoides* Haldeman.
 1966. *directa* Newman.
 1967. *Gaurotes cygnipennis* Say.
 1968. *Strangalia fumelica* Newman.
 1969. *acuminata* Olivier.
 1970. *luteicornis* Fabricius.
 1971. *bicolor* Swederus.
 1972. *Typocerus zebratus* Fabricius.
 1973. *lunatus* Fabricius.
 1974. *velutinus* Olivier.
 1975. *lugubris* Say.
 1976. *sinuatus* Newman.
 1977. *Leptura emarginata* Olivier.
 1978. *subhamata* Randall.
 1979. *lineola* Say.
 1980. *hæmatites* Newman.
 1981. *subargentata* Kirby.
 1982. *nitens* Forster.
 1983. *cordifera* Olivier.
 1984. *rubrica* Jay.
 1985. *circumdata* Olivier.
 1986. *vagans* Olivier.
 1987. *proxima* Say.
 1988. *vittata* Germar.
 1989. *pubera* Say.
 1990. *mutabilis* Newman.
 1991. *Euryptera lateralis* Olivier.
 1992. *Cyrtinus pygmeus* Haldeman.
 1993. *Psenocerus supernotatus* Say.
 1994. *Monohammus titillator* Fabricius.
 1995. *confusor* Kirby.
 1996. *scutellatus* Say.
 1997. *Dorcaschema wildii* Uhler.
 1998. *alternatum* Say.
 1999. *nigrum* Say.
 2000. *Hetermis cinerea* Olivier.
 2001. *Cæcophia pullata* Haldeman.
 2002. *Goes tigrina* De Geer.
 2003. *pulehra* Haldeman.
 2004. *debilis* Le Conte.
 2005. *tessellata* Haldeman.
 2006. *puberulenta* Haldeman.
 2007. *oculata* Le Conte.
 2008. *Plectrodera scalator* Fabricius.
 2009. *Acanthoderes quadrigibbus* Say.
 2010. *decipiens* Haldeman.
 2011. *morrisii* Uhler.
 2012. *Leptostylus aculiferus* Say.

LIST OF SPECIES—Continued.

2013. <i>Leptostylus parvus</i> Le Conte.	<i>CHRYSOMELIDÆ.</i>
2014. <i>biustus</i> Le Conte.	
2015. <i>commixtus</i> Haldeman.	2064. <i>Donacia cineticornis</i> Newman.
2016. <i>collaris</i> Haldeman.	2065. <i>palmata</i> Olivier.
2017. <i>macula</i> Say.	2066. <i>hypoleuca</i> Lacordaire.
2018. <i>Liopus variegatus</i> Haldeman.	2067. <i>piscatrice</i> Lacordaire.
2019. <i>crassulus</i> Le Conte.	2068. <i>subtilis</i> Kunze.
2020. <i>fascicularis</i> Harris.	2069. <i>porosicollis</i> Lacordaire.
2021. <i>alpha</i> Say.	2070. <i>æqualis</i> Say.
2022. <i>var. cinereus</i> Le Conte.	2071. <i>tuberculata</i> Lacordaire.
2023. <i>punctatus</i> Le Conte.	2072. <i>distincta</i> Le Conte.
2024. <i>Dectes spinosus</i> Say.	2073. <i>pusilla</i> Say.
2025. <i>Lepturges symmetricus</i> Haldeman.	2074. <i>metallica</i> Ahrens.
2026. <i>quercus</i> Fitch.	2075. <i>flavipes</i> Kirby.
2027. <i>signatus</i> Le Conte.	2076. <i>Hæmonia nigricornis</i> Kirby.
2028. <i>facetus</i> Say.	2077. <i>Orsodacta atra</i> Ahrens.
2029. <i>Hyperplatys aspersus</i> Say.	2078. <i>Zengophora puberula</i> Crotch.
2030. <i>Trographis fasciata</i> De Geer.	2079. <i>Stycta ferruginea</i> Germar.
2031. <i>Ceratographis pusilla</i> Kirby.	2080. <i>Lema brunnicollis</i> Lacordaire.
2032. <i>Acanthocinus obsoletus</i> Olivier.	2081. <i>sapi</i> Crotch.
2033. <i>nodosus</i> Fabricius.	2082. <i>6-punctata</i> Olivier.
2034. <i>Pogonocherus mixtus</i> Haldeman.	2083. <i>var. ephippiata</i> Lacordaire.
2035. <i>Ecyrus dusycerus</i> Say.	2084. <i>3-lineata</i> Olivier.
2036. <i>Eupogonius tomentosus</i> Haldeman.	2085. <i>Crioceris asparagi</i> Linnæus.
2037. <i>restitus</i> Say.	2086. <i>12-punctata</i> Linnæus.
2038. <i>pubescens</i> Le Conte.	2087. <i>Anomea laticlaria</i> Forster.
2039. <i>subarmatus</i> Le Conte.	2088. <i>Coscinoptera dominicana</i> Fabricius.
2040. <i>Oncideres cingulata</i> Say.	2089. <i>Babia 4-guttata</i> Olivier.
2041. <i>Ataxia crypta</i> Say.	2090. <i>Saxinis omogera</i> Lacordaire.
2042. <i>Hippopsis limniscata</i> Fabricius.	2091. <i>Chlamys plicata</i> Fabricius.
2043. <i>Supera obliqua</i> Say.	2092. <i>var. assimilis</i> Klug.
2044. <i>candida</i> Fabricius.	2093. <i>Exema gibber</i> Olivier.
2045. <i>discoidea</i> Fabricius.	2094. <i>conspersa</i> Mannerheim.
2046. <i>lateralis</i> Fabricius.	2095. <i>Bassaricus congestus</i> Fabricius.
2047. <i>tridentata</i> Olivier.	2096. <i>formosus</i> Melsheimer.
2048. <i>restita</i> Say.	2097. <i>var. sulphuripennis</i> Mels-
2049. <i>puncticollis</i> Say.	<i>heimer.</i>
2050. <i>Oberea bimaculata</i> Olivier.	2098. <i>detritus</i> Olivier.
2051. <i>tripunctata</i> Swederus.	2099. <i>mammifer</i> Newman.
2052. <i>flavipes</i> Haldeman.	2100. <i>var. luteipennis</i> Mels-
2053. <i>ocellata</i> Haldeman.	<i>heimer.</i>
2054. <i>gracilis</i> Fabricius.	2101. <i>lituratus</i> Fabricius.
2055. <i>ruficollis</i> Fabricius.	2102. <i>var. lativittis</i> Germar.
2056. <i>Tetrops monostigma</i> Haldeman.	2103. <i>Cryptocephalus quadrimaculatus</i> Say.
2057. <i>jucunda</i> Le Conte.	2104. <i>binominis</i> Newman.
2058. <i>Tetraopes tetraophthalmus</i> Forster.	2105. <i>quadruplex</i> Newman.
2059. <i>canteriator</i> Drapiez.	2106. <i>guttulatus</i> Olivier.
2060. <i>5-maculatus</i> Haldeman.	2107. <i>leucomelas</i> Suffrian.
2061. <i>Amphionycha flammata</i> Newman.	2108. <i>remus</i> Fabricius.
2062. <i>Dysphaga tenuipes</i> Haldeman.	2109. <i>var. ornatus</i> Fabri-
2063. <i>levis</i> Le Conte.	<i>cus.</i>

LIST OF SPECIES—Continued.

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|-------|---|-------|--|
| 2110. | <i>Cryptocephalus</i> var. <i>hamatus</i> Melsheimer. | 2151. | <i>Graphops curtipes</i> Melsheimer. |
| 2111. | var. <i>simplex</i> Haldeman. | 2152. | <i>Typhophorus viridicyaneus</i> Crotch. |
| 2112. | <i>insertus</i> Haldeman. | 2153. | <i>canellus</i> Fabricius. |
| 2113. | <i>calidus</i> Suffrian. | 2154. | var. <i>6-notata</i> Say. |
| 2114. | <i>albicans</i> Haldeman. | 2155. | var. <i>4-notata</i> Say. |
| 2115. | <i>gibbicollis</i> Haldeman. | 2156. | var. <i>aterrima</i> Olivier. |
| 2116. | <i>trivittatus</i> Olivier. | 2157. | var. <i>thoracica</i> Melsheimer. |
| 2117. | <i>mutabilis</i> Melsheimer. | 2158. | <i>Metachroma quercatum</i> Fabricius. |
| 2118. | var. <i>dispersus</i> Haldeman. | 2159. | <i>pallidum</i> Say. |
| 2119. | <i>badius</i> Suffrian. | 2160. | <i>laterale</i> Crotch. |
| 2120. | <i>schreibersii</i> Suffrian. | 2161. | <i>lavicolle</i> Crotch. |
| 2121. | <i>striatulus</i> Le Conte. | 2162. | <i>Chrysochus auratus</i> Fabricius. |
| 2122. | <i>Griburius equestris</i> Olivier. | 2163. | <i>Tymnes tricolor</i> Fabricius. |
| 2123. | <i>Pachybrachys</i> ¹ <i>othonus</i> Say. | 2164. | <i>Colaspis brunnea</i> Fabricius. |
| 2124. | <i>trinitatus</i> Melsheimer. | 2165. | <i>favosa</i> Say. |
| 2125. | <i>intricatus</i> Suffrian. | 2166. | <i>Rhabdopterus picipes</i> Olivier. |
| 2126. | <i>tridens</i> Melsheimer. | 2167. | <i>Nolonota puncticollis</i> Say. |
| 2127. | <i>carbonarius</i> Le Conte. | 2168. | <i>tristis</i> Olivier. |
| 2128. | <i>luridus</i> Fabricius. | 2169. | <i>Prasocneris raripes</i> Le Conte. |
| 2129. | <i>atomarius</i> Melsheimer. | 2170. | <i>Labidomera clivicollis</i> Kirby. |
| 2130. | <i>infustus</i> Haldeman. | 2171. | <i>Leptinotarsa decemlineata</i> Say. |
| 2131. | <i>hepaticus</i> Melsheimer. | 2172. | <i>juncta</i> Germar. |
| 2132. | <i>subfasciatus</i> Haldeman. | 2173. | <i>Zygogramma suturalis</i> Fabricius. |
| 2133. | <i>dilatatus</i> Suffrian. | 2174. | <i>Calligrapha similis</i> Rogers. |
| 2134. | <i>Monachus ater</i> Haldeman. | 2175. | <i>elegans</i> Olivier. |
| 2135. | <i>saponatus</i> Fabricius. | 2176. | <i>scalaris</i> Le Conte. |
| 2136. | <i>Diachus auratus</i> Fabricius. | 2177. | <i>philadelphica</i> Linnæus. |
| 2137. | <i>levis</i> Haldeman. | 2178. | var. <i>spireæ</i> Say. |
| 2138. | <i>catarius</i> Suffrian. | 2179. | <i>bigsbiana</i> Kirby. |
| 2139. | <i>pallidicornis</i> Suffrian. | 2180. | <i>Plagioderia viridis</i> Melsheimer. |
| 2140. | <i>Triachus atomus</i> Suffrian. | 2181. | <i>seruginosa</i> Suffrian. |
| 2141. | <i>vacuus</i> Le Conte. | 2182. | <i>Gastroidea cyanea</i> Melsheimer. |
| 2142. | <i>Fidia viticida</i> Walsh. | 2183. | <i>Lina lapponica</i> Linnæus. |
| 2143. | <i>longipes</i> Melsheimer. | 2184. | <i>scripta</i> Fabricius. |
| 2144. | <i>Xanthonia 10-notata</i> Say. | 2185. | <i>Monocesta coryli</i> Say. |
| 2145. | <i>villosula</i> Melsheimer. | 2186. | <i>Trirhabda tomentosa</i> Linnæus. |
| 2146. | <i>Myochrous denticollis</i> Say. | 2187. | <i>virgata</i> Le Conte. |
| 2147. | <i>Glyptoseclis pubescens</i> Fabricius. | 2188. | <i>Galerucella americana</i> Fabricius. |
| 2148. | <i>barbata</i> Say. | 2189. | <i>6-vittata</i> Le Conte. |
| 2149. | <i>Graphops pubescens</i> Melsheimer. | 2190. | <i>rufosanguinea</i> Say. |
| 2150. | <i>marcassita</i> Crotch. | 2191. | <i>integra</i> Le Conte. |
| | | 2192. | <i>notulata</i> Fabricius. |
| | | 2193. | <i>notata</i> Fabricius. |
| | | 2194. | <i>nymphææ</i> Linnæus. |
| | | 2195. | <i>tuberculata</i> Say. |
| | | 2196. | <i>decora</i> Say. |
| | | 2197. | <i>xanthomelana</i> Schrank. |
| | | 2198. | <i>Diabrotica 12-punctata</i> Fabricius. |
| | | 2199. | <i>atripennis</i> Say. |
| | | 2200. | <i>vittata</i> Fabricius. |

¹ Also some unrecognized forms.

LIST OF SPECIES—Continued.

2201. *Phyllobrotica discoidea* Fabricius.
 2202. *limbata* Fabricius.
 2203. *Luperodes cyanellus* Le Conte.
 2204. *meruca* Say.
 2205. *Phyllechthrus dorsalis* Olivier.
 2206. *gentilis* Le Conte.
 2207. *Cerotoma trifurcata* Forster.
 2208. *Blepharida rhois* Forster.
 2209. *Pachyonychus paradorus* Melsheimer.
 2210. *Hypolampsis pilosa* Illiger.
 2211. *Edionychis gibbittarsis* Say.
 2212. *thoracica* Fabricius.
 2213. *vians* Illiger.
 2214. *fimbriata* Forster.
 2215. *peturista* Fabricius.
 2216. *miniata* Fabricius.
 2217. *indigoptera* Le Conte.
 2218. *limbalis* Melsheimer.
 2219. *6-maculata* Illiger.
 2220. *quercata* Fabricius.
 2221. *Disonycha pennsylvanica* Illiger.
 2222. *5-vittata* Say.
 2223. *crenicollis* Say.
 2224. *caroliniana* Fabricius.
 2225. *glabrata* Fabricius.
 2226. *abbreviata* Melsheimer.
 2227. *xanthomelæna* Dalman.
 2228. *collata* Fabricius.
 2229. *Sphaeroderma opina* Le Conte.
 2230. *Haltica chalybea* Illiger.
 2231. *ignita* Illiger.
 2232. *amæna* Horn.
 2233. *fuscoænea* Melsheimer.
 2234. *marevagens* Horn.
 2235. *rufa* Haldeman.
 2236. *Lactica iris* Olivier.
 2237. *tibialis* Olivier.
 2238. *Diphatalca bicolorata* Horn.
 2239. *Orthaltica copalina* Fabricius.
 2240. *Crepidodera rufipes* Linnaeus.
 2241. *helvæus* Linnaeus.
 2242. *atrirentris* Melsheimer.
 2243. *Epitrix cucumeris* Harris.
 2244. *fuscula* Crotch.
 2245. *parvula* Fabricius.
 2246. *Luperaltica fuscula* Le Conte.
 2247. *Mantura floridana* Crotch.
 2248. *Chatocnema subcylindrica* Le Conte.
 2249. *protensa* Le Conte.
 2250. *denticulata* Illiger.
 2251. *parcepunctata* Crotch.
 2252. *Chatocnema pulicaria* Melsheimer.
 2253. *crenulata* Crotch.
 2254. *confinis* Crotch.
 2255. *minuta* Melsheimer.
 2256. *Systema hudsonius* Forster.
 2257. *frontalis* Fabricius.
 2258. *elongata* Fabricius.
 2259. *taniata* Say.
 2260. *marginalis* Illiger.
 2261. *Glyptina spuria* Le Conte.
 2262. *brunnea* Horn.
 2263. *Aphthona insolita* Melsheimer.
 2264. *Phyllotreta sinuata* Stephens.
 2265. *vittata* Fabricius.
 2266. *bipustulata* Fabricius.
 2267. *picta* Say.
 2268. *Longitarsus melanurus* Melsheimer.
 2269. *testaceus* Melsheimer.
 2270. *subrufus* Le Conte.
 2271. *turbatus* Horn.
 2272. *pygmaeus* Horn.
 2273. *Dibolia borealis* Chevrolat.
 2274. *Psylliodes convexior* Le Conte.
 2275. *Microrhopala vittata* Fabricius.
 2276. *xerene* Newman.
 2277. *excavata* Olivier.
 2278. *cyanea* Say.
 2279. *porcata* Melsheimer.
 2280. *melsheimeri* Crotch.
 2281. *Odontota scapularis* Olivier.
 2282. *bicolor* Olivier.
 2283. *horni* Smith.
 2284. *dorsalis* Thunberg.
 2285. *rubra* Weber.
 2286. *nerrosa* Panzer.
 2287. *Charistena ariadne* Newman.
 2288. *Octotoma plicatula* Olivier.
 2289. *Stenispis metallica* Fabricius.
 2290. *Cassida nigripes* Olivier.
 2291. *birittata* Say.
 2292. *Coptocycla clarata* Fabricius.
 2293. *signifera* Herbst.
 2294. *purpurata* Boheman.
 2295. *bicolor* Fabricius.
 2296. *Chelymorphia argus* Liechtenstein.
- BRUCHIDÆ.
2297. *Spermophagus robinia* Schönherr.
 2298. *Bruchus pisorum* Linnaeus.
 2299. *minus* Say.
 2300. *chinensis* Linnaeus.
 2301. *4-maculatus* Fabricius.

LIST OF SPECIES—Continued.

2302. *Bruchus discoideus* Say.
 2303. *bivulcratus* Horn.
 2304. *crucentatus* Horn.
 2305. *nigrinus* Horn.
 2306. *alboscintellatus* Horn.
 2307. *perforatus* Horn.
 2308. *distinguendus* Horn.
 2309. *fraterculus* Horn.
 2310. *obsolitus* Say.
 2311. *obtectus* Say.
 2312. *hibisci* Olivier.
 2313. *longistylus* Horn.
 2314. *musculus* Say.
 2315. *exiguus* Horn.
 2316. *seminulum* Horn.
 2317. *macrocerus* Horn.
 2318. *Zabrotes obliteratus* Horn.
 2319. *subnitens* Horn.
- TENEBRIONIDÆ.
2320. *Epitragus arundinis* Le Conte.
 2321. *Phellopsis orbodata* Kirby.
 2322. *Blaps similis* Latreille.
 2323. *Polypleurus geminatus* Solier.
 2324. *Alobates pennsylvanica* De Geer.
 2325. *Merinus laevis* Olivier.
 2326. *Haplodrus femoratus* Fabricius.
 2327. *ater* Le Conte.
 2328. *Scotobates calcaratus* Fabricius.
 2329. *Xylopinus rufipes* Say.
 2330. *saperdoides* Olivier.
 2331. *vesecens* Le Conte.
 2332. *Tenebrio obscurus* Fabricius.
 2333. *molitor* Linnaeus.
 2334. *castaneus* Knoch.
 2335. *tenebrionides* Beauvois.
 2336. *Opatrinus notus* Say.
 2337. *Blapstinus mastus* Melsheimer.
 2338. *interruptus* Say.
 2339. *metallicus* Fabricius.
 2340. *Tribolium ferrugineum* Fabricius.
 2341. *confusum* Duval.
 2342. *Lyphia fuscicola* Mulsant.
 2343. *Diardus punctatus* Le Conte.
 2344. *Echocerus macillosus* Fabricius.
 2345. *dentiger* Chittenden.
 2346. *Alphitobius diaperinus* Panzer.
 2347. *Ulonia impressa* Melsheimer.
 2348. *imberbis* Le Conte.
 2349. *punctulata* Le Conte.
 2350. *Eutochia picca* Melsheimer.
 2351. *Anedus brunneus* Ziegler.
2352. *Paratenetus punctatus* Solier.
 2353. *fuscus* Le Conte.
 2354. *gibbipennis* Motschulsky.
 2355. *Prateus fuscus* Le Conte.
 2356. *Diaperis hydni* Fabricius.
 2357. *Arrhenoplita bicornis* Olivier.
 2358. *viridipennis* Fabricius.
 2359. *Platydema excavatum* Say.
 2360. *erythrocerum* Laporte.
 2361. *ruficollis* Laporte.
 2362. *ruficornis* Sturm.
 2363. *flavipes* Fabricius.
 2364. *ellipticum* Fabricius.
 2365. *micans* Horn.
 2366. *crenatum* Le Conte.
 2367. *picilabrum* Melsheimer.
 2368. *subcostatum* Laporte.
 2369. *Phylethus bifasciatus* Say.
 2370. *Palorus ratzeburgi* Wissmann.
 2371. *subdepressus* Wollaston.
 2372. *Hypophlaeus parallelus* Melsheimer.
 2373. *caesus* Le Conte.
 2374. *thoracicus* Melsheimer.
 2375. *piliger* Le Conte.
 2376. *Pentaphyllus pallidus* Le Conte.
 2377. *Boletothecus bifurcus* Fabricius.
 2378. *Boletophagus corticola* Say.
 2379. *Helops micans* Fabricius.
 2380. *americanus* Beauvois.
 2381. *venustus* Say.
 2382. *areus* Germar.
 2383. *Meracantha contracta* Beauvois.
 2384. *Strongylium tenuicollis* Say.
 2385. *terminatum* Say.
- CISTELIDÆ.
2386. *Allecula punctulata* Melsheimer.
 2387. *atra* Say.
 2388. *Hymenorus niger* Melsheimer.
 2389. *pilosus* Melsheimer.
 2390. *obscurus* Say.
 2391. *communis* Le Conte.
 2392. *rufipes* Le Conte.
 2393. *Cistela brevis* Say.
 2394. *marginata* Ziegler.
 2395. *Isomira valida* Schwarz.
 2396. *sericca* Say.
 2397. *quadristriata* Couper.
 2398. *Mycetochares haldemani* Le Conte.
 2399. *fraterna* Say.
 2400. *binotata* Say.
 2401. *foveata* Le Conte.

LIST OF SPECIES—Continued.

2402. *Chromatia amarna* Say.
 2403. *Capuochroa fuliginosa* Melsheimer.
 2404. *Androchirus fuscipes* Melsheimer.
 2405. *femorialis* Olivier.
- LAGRIID.E.
2406. *Arthromacra xnea* Say.
 2407. *Statira resplendens* Melsheimer.
 2408. *gagatina* Melsheimer.
- MONOMMID.E.
2409. *Hyporhagus punctulatus* Thomson.
- MELANDRYID.E.
2410. *Tetratoma truncorum* Le Conte.
 2411. *tessellata* Melsheimer.
 2412. *Piscus humeralis* Kirby.
 2413. *Penthe obliquata* Fabricius.
 2414. *pimelia* Fabricius.
 2415. *Synchroa punctata* Newman.
 2416. *Eustrophus bicolor* Fabricius.
 2417. *repandus* Horn.
 2418. *tonentosus* Say.
 2419. *Holostrophus bifasciatus* Say.
 2420. *Orchesia castanea* Melsheimer.
 2421. *gracilis* Melsheimer.
 2422. *Hallomenus scapularis* Melsheimer.
 2423. *debilis* Le Conte.
 2424. *Microscapha clavicornis* Le Conte.
 2425. *Melandrya striata* Say.
 2426. *Carebara longula* Le Conte.
 2427. *Spilotus 4-pustulosus* Melsheimer.
 2428. *Enchodes sericea* Haldeman.
 2429. *Mystaxia simulator* Newman.
 2430. *Hypulus lituratus* Le Conte.
 2431. *concolor* Le Conte.
 2432. *vandoueri* Mulsant.
 2433. *Symphora flavicollis* Haldeman.
 2434. *rugosa* Haldeman.
 2435. *Anisoxya glaucula* Le Conte.
 2436. *Scraptia sericea* Melsheimer.
 2437. *Allopoda lutea* Haldeman.
 2438. *Canifa plagiata* Melsheimer.
 2439. *pusilla* Haldeman.
 2440. *pallipes* Melsheimer.
 2441. *Nothus varians* Le Conte.
 2442. *Mycterus scaber* Haldeman.
- PYTHID.E.
2443. *Boros unicolor* Say.
 2444. *Pytho americanus* Kirby.
2445. *Salpingus vireescens* Le Conte.
 2446. *Rhinosimus viridivirens* Randall.
- EDEMERID.E.
2447. *Microtonus sericans* Le Conte.
 2448. *Nacervedes melanura* Linnaeus.
 2449. *Oxacis thoracica* Fabricius.
 2450. *teniata* Le Conte.
 2451. *Probosea pleuralis* Le Conte.
 2452. *Asclera ruficollis* Say.
 2453. *puncticollis* Say.
- MORDELLID.E.
2454. *Pentaria trifasciata* Melsheimer.
 2455. *Anaspis flavipennis* Haldeman.
 2456. *rufa* Say.
 2457. *Tomoxia lineella* Le Conte.
 2458. *inclusa* Le Conte.
 2459. *Mordella melena* Germar.
 2460. *scutellaris* Fabricius.
 2461. *irrorata* Le Conte.
 2462. *8-punctata* Fabricius.
 2463. *marginata* Melsheimer.
 2464. *lunulata* Helmhuth.
 2465. var. *obliqua* Le Conte.
 2466. *serval* Say.
 2467. *oculata* Say.
 2468. *triloba* Say.
 2469. *undulata* Melsheimer.
 2470. *fascifera* Le Conte.
 2471. *discoidea* Melsheimer.
 2472. *Mordellistena bicinctella* Le Conte.
 2473. *arida* Le Conte.
 2474. *lutea* Melsheimer.
 2475. *trifasciata* Say.
 2476. *lepidula* Le Conte.
 2477. *limbalis* Melsheimer.
 2478. *biplagiata* Helmhuth.
 2479. *rapida* Le Conte.
 2480. *decorata* Le Conte.
 2481. *fulvicollis* Melsheimer.
 2482. *ornata* Melsheimer.
 2483. *nitidaris* Le Conte.
 2484. *scapularis* Say.
 2485. *conata* Le Conte.
 2486. var. *cervicalis* Le Conte.
 2487. var. *picicornis* Le Conte.
 2488. *amica* Le Conte.

LIST OF SPECIES—Continued.

2489. *Mordellistena aspersa* Melsheimer.
 2490. *picilabris* Helmuth.
 2491. *inifina* Le Conte.
 2492. *andrea* Le Conte.
 2493. *grammica* Le Conte.
 2494. *ancilla* Le Conte.
 2495. *ravians* Le Conte.
 2496. *ustulata* Le Conte.
 2497. *semitusta* Le Conte.
 2498. *impatiens* Le Conte.
 2499. *nigricans* Melsheimer.
 2500. *ruficeps* Le Conte.
 2501. *pustulata* Melsheimer.
 2502. *convicta* Le Conte.
 2503. *fuscipennis* Melsheimer.
 2504. *morula* Le Conte.
 2505. *ambusta* Le Conte.
 2506. *unicolor* Le Conte.
 2507. *marginalis* Say.
 2508. *pubescens* Fabricius.
 2509. var. *leporina* Le Conte.
 2510. var. *hebraica* Le Conte.
 2511. *bihamata* Melsheimer.
 2512. *liturata* Melsheimer.
 2513. *fusca* Melsheimer.
 2514. *saturata* Helmuth.
 2515. *attenuata* Say.
 2516. *discolor* Melsheimer.
- ANTHICID.E.
2517. *Stereopalpus nellyi* Laferté.
 2518. *Corphyra terminalis* Say.
 2519. *labiata* Say.
 2520. *lugubris* Say.
 2521. *collaris* Say.
 2522. *Xylophilus melsheimeri* Le Conte.
 2523. *basalis* Le Conte.
 2524. *nebulosus* Le Conte.
 2525. *fasciatus* Melsheimer.
 2526. *subfasciatus* Le Conte.
 2527. *notatus* Le Conte.
 2528. *piceus* Le Conte.
 2529. *brunnipennis* Le Conte.
 2530. *impressus* Le Conte.
 2531. *Macratia confusa* Le Conte.
 2532. *murina* Fabricius.
 2533. *Notorus anchora* Hentz.
 2534. *monodon* Fabricius.
 2535. *bicolor* Say.
 2536. *Mecynotarsus candidus* Le Conte.
 2537. *Tomoderus constrictus* Say.
2538. *Anthicus sturmi* Laferté.
 2539. *myrmecoides* Hamilton.
 2540. *cinctus* Say.
 2541. *floralis* Linnæus.
 2542. *vicinus* Laferté.
 2543. *confusus* Le Conte.
 2544. *scabriceps* Le Conte.
 2545. *cervinus* Laferté.
 2546. *latebrans* Le Conte.
 2547. *spretus* Le Conte.
 2548. *pubescens* Le Conte.
 2549. *fulripes* Laferté.
 2550. *haldemani* Le Conte.
- PYROCHROID.E.
2551. *Ischalia costata* Le Conte.
 2552. *Pyrochroa flabellata* Fabricius.
 2553. *femoralis* Le Conte.
 2554. *Dendroides canadensis* Latreille.
- MELOID.E.
2555. *Meloe angusticollis* Say.
 2556. *americanus* Leach.
 2557. *macrens* Le Conte.
 2558. *Tricrania sanguinipennis* Say.
 2559. *Nemognatha nemorensis* Hentz.
 2560. *cribraria* Le Conte.
 2561. *Zonitis bilineata* Say.
 2562. *Hornia minutipennis* Riley.
 2563. *Macrobasis unicolor* Kirby.
 2564. *Epicauda pennsylvanica* De Geer.
 2565. *cinerea* Forster.
 2566. *vittata* Fabricius.
 2567. *lenniscata* Fabricius.
 2568. *strigosa* Schönherr.
 2569. *trichrus* Pallas.
 2570. *Pyrota germari* Haldeman.
 2571. *limbalis* Le Conte.
 2572. *Pomphopora venea* Say.
- RHIPIDORID.E.
2573. *Pelecotoma flavipes* Melsheimer.
 2574. *Rhipidorus pectinatus* Fabricius.
 2575. *cruentus* Germar.
 2576. *limbatus* Fabricius.
 2577. *Myodites fasciatus* Say.
 2578. var. *styloides* Newman.
- STYLOPID.E.
2579. *Xenos peckii* Kirby.

LIST OF SPECIES—Continued.

	<i>RHINOMACERID.E.</i>	2621. <i>Apion patrule</i> Smith.
		2622. <i>walshii</i> Smith.
2580. <i>Rhinomacer pilosus</i> Le Conte.		2623. <i>perforicolle</i> Fall.
2581. <i>elongatus</i> Le Conte.		2624. <i>norellum</i> Fall.
	<i>RHYNCHITID.E.</i>	2625. <i>turbulentum</i> Smith.
		2626. <i>griseum</i> Smith.
2582. <i>Auletes cassandrae</i> Le Conte.		2627. <i>porcatum</i> Boheman.
2583. <i>Eugnamptus angustatus</i> Herbst.		2628. <i>rostrum</i> Say.
2584. <i>collaris</i> Fabricius.		2629. <i>nigrum</i> Herbst.
2585. <i>Rhynchites hirtus</i> Fabricius.		2630. <i>sequipes</i> Say.
2586. <i>veneus</i> Boheman.		2631. <i>ventricosum</i> Le Conte.
2587. <i>aratus</i> Say.		2632. <i>decoloratum</i> Fall.
2588. <i>Pterocolus oratus</i> Fabricius.		2633. <i>emacipes</i> Fall.
	<i>ATTELABID.E.</i>	2634. <i>carinatum</i> Smith.
		2635. <i>parallellum</i> Smith.
2589. <i>Attelabus analis</i> Illiger.		2636. <i>paritanum</i> Fall.
2590. <i>nigripes</i> Le Conte.		2637. <i>herculanum</i> Smith.
2591. <i>bipustulatus</i> Fabricius.		2638. <i>Podapion gallicola</i> Riley.
	<i>OTIORHYNCHID.E.</i>	2639. <i>Phytonomus comptus</i> Say.
		2640. <i>punctatus</i> Schönherr.
2592. <i>Epicærus imbricatus</i> Say.		2641. <i>Listronotus tuberosus</i> Le Conte.
2593. <i>Hormorus undulatus</i> Uhler.		2642. <i>callosus</i> Le Conte.
2594. <i>Panscopus erinaceus</i> Say.		2643. <i>inequalipennis</i> Boheman.
2595. <i>Phyxelis rigidus</i> Say.		2644. <i>caudatus</i> Say.
2596. <i>Otiorynchus oratus</i> Linnaeus.		2645. <i>appendiculatus</i> Boheman.
2597. <i>sulcatus</i> Fabricius.		
2598. <i>Cercopeus chrysorhynchus</i> Say.		2646. <i>sulcirostris</i> Le Conte.
2599. <i>Tangmeicus confertus</i> Gyllenhal.		2647. <i>latiusculus</i> Boheman.
2600. <i>Pandeletejus hilaris</i> Herbst.		2648. <i>Macrops solutus</i> Boheman.
2601. <i>Brachystylus acutus</i> Say.		2649. <i>sparvus</i> Say.
2602. <i>Aramigus fulleri</i> Horn.		2650. <i>porcellus</i> Say.
2603. <i>Aphrastus taniatus</i> Gyllenhal.		2651. <i>Pissodes strobi</i> Peck.
	<i>CURCULIONID.E.</i>	2652. <i>Pachylobius picivorus</i> Germar.
		2653. <i>Hylobius pales</i> Herbst.
2604. <i>Sitones flavescens</i> Marsham.		2654. <i>Endocimus mannerheimii</i> Boheman
2605. <i>hispidulus</i> Germar.		2655. <i>Lixus terminalis</i> Le Conte.
2606. <i>Ithycerus noreboracensis</i> Forster.		2656. <i>rectus</i> Le Conte.
2607. <i>Apion impeditum</i> Fall.		2657. <i>concarus</i> Say.
2608. <i>impunctistriatum</i> Smith.		2658. <i>musculus</i> Say.
2609. <i>coracellum</i> Fall.		2659. <i>scrobicollis</i> Boheman.
2610. <i>atripes</i> Smith.		2660. <i>sylvius</i> Boheman.
2611. <i>finitimum</i> Fall.		2661. <i>juetichi</i> Casey.
2612. <i>melanarium</i> Gerstäcker.		2662. <i>Dorytomus brevicollis</i> Le Conte.
2613. <i>robustum</i> Smith.		2663. <i>Pachyphancus amenus</i> Say.
2614. <i>minutum</i> Smith.		2664. <i>Smicronyx squalidus</i> Casey.
2615. <i>pennsylvanicum</i> Boheman.		2665. <i>tessellatus</i> Dietz.
2616. <i>perminutum</i> Smith.		2666. <i>languidulus</i> Dietz.
2617. <i>reclusum</i> Fall.		2667. <i>atratus</i> Dietz.
2618. <i>coerule</i> Fall.		2668. <i>congestus</i> Casey.
2619. <i>tenuirostrum</i> Smith.		2669. <i>sculpticollis</i> Casey.
2620. <i>vincipenne</i> Smith.		2670. <i>apionides</i> Casey.

LIST OF SPECIES—Continued.

2671. <i>Smicromys nebulosus</i> Dietz.	2722. <i>Anthonomus nubilus</i> Le Conte.
2672. <i>maculatus</i> Dietz.	2723. <i>elongatus</i> Le Conte.
2673. <i>corniculatus</i> Fabricius.	2724. <i>Pseudanthonomus cratagi</i> Walsh.
2674. <i>lunuginosus</i> Dietz.	2725. <i>incipiens</i> Dietz.
2675. <i>sparsus</i> Casey.	2726. <i>seriesetosus</i> Dietz.
2676. <i>Promecotarsus gibbirostris</i> Casey.	2727. <i>longulus</i> Dietz.
2677. <i>Phyllotrox ferrugineus</i> Le Conte.	2728. <i>rufulus</i> Dietz.
2678. <i>Brachybanus electus</i> Germar.	2729. <i>Xanthus pygmaeus</i> Dietz.
2679. <i>Omychylis nigrirostris</i> Boheman.	2730. <i>uliputanus</i> Dietz.
2680. <i>Endalus limatulus</i> Gyllenhal.	2731. <i>Elleschus ephippiatus</i> Say.
2681. <i>cribricollis</i> Le Conte.	2732. <i>Acalyptus carpini</i> Herbst.
2682. <i>oralis</i> Le Conte.	2733. <i>Orchestes salicis</i> Linnæus.
2683. <i>Tanyssphyrus lemnae</i> Fabricius.	2734. <i>niger</i> Horn.
2684. <i>Anchodemus angustus</i> Le Conte.	2735. <i>pallidicornis</i> Say.
2685. <i>Lissorhoptus simplex</i> Say.	2736. <i>betuleti</i> Horn.
2686. <i>apiculatus</i> Gyllenhal.	2737. <i>Prionomerus calcitrans</i> Say.
2687. <i>Bagous</i> ¹ <i>mammillatus</i> Say.	2738. <i>Piazorhinus scutellaris</i> Say.
2688. <i>magister</i> Le Conte.	2739. <i>pictus</i> Le Conte.
2689. <i>transversus</i> Le Conte.	2740. <i>Thysanocnemis helveticus</i> Le Conte.
2690. <i>bituberosus</i> Le Conte.	2741. <i>fraxini</i> Le Conte.
2691. <i>Otidoccephalus myrmæe</i> Herbst.	2742. <i>Plocetes ulmi</i> Le Conte.
2692. <i>cherrolati</i> Horn.	2743. <i>Gymnetron teter</i> Fabricius.
2693. <i>laticollis</i> Horn.	2744. <i>Miarus hispidulus</i> Le Conte.
2694. <i>serobicollis</i> Boheman.	2745. <i>Lanosaccus plagiatus</i> Fabricius.
2695. <i>Magdalis perforata</i> Horn.	2746. <i>Conotrachelus juglandis</i> Le Conte.
2696. <i>olyra</i> Herbst.	2747. <i>albicinctus</i> Le Conte.
2697. <i>hispidoides</i> Le Conte.	2748. <i>nenuphar</i> Herbst.
2698. <i>pandura</i> Say.	2749. <i>seniculus</i> Le Conte.
2699. <i>pallida</i> Say.	2750. <i>affinis</i> Boheman.
2700. <i>Tachypterus quadrigibbus</i> Say.	2751. <i>elegans</i> Say.
2701. <i>Anthonomus rubidus</i> Le Conte.	2752. <i>cratagi</i> Walsh.
2702. <i>gularis</i> Le Conte.	2753. <i>naso</i> Le Conte.
2703. <i>virgo</i> Dietz.	2754. <i>posticatus</i> Boheman.
2704. <i>sycophanta</i> Walsh.	2755. <i>geminatus</i> Le Conte.
2705. <i>suturalis</i> Le Conte.	2756. <i>cribricollis</i> Say.
2706. <i>corrulus</i> Le Conte.	2757. <i>tuberosus</i> Le Conte.
2707. <i>subquittatus</i> Dietz.	2758. <i>anaglypticus</i> Say.
2708. <i>signatus</i> Say.	2759. <i>fissunguis</i> Le Conte.
2709. <i>consimilis</i> Dietz.	2760. <i>erinaceus</i> Le Conte.
2710. <i>musculus</i> Say.	2761. <i>hispidus</i> Le Conte.
2711. <i>sulcifrons</i> Le Conte.	2762. <i>Rhyssematus lineaticollis</i> Say.
2712. <i>interstitialis</i> Dietz.	2763. <i>aqualis</i> Horn.
2713. <i>nigrinus</i> Boheman.	2764. <i>Chalcoedermus collaris</i> Horn.
2714. <i>scutellatus</i> Gyllenhal.	2765. <i>Microhqus setiger</i> Le Conte.
2715. <i>juniperinus</i> Sanborn.	2766. <i>Acamptus rigidus</i> Le Conte.
2716. <i>orchestoides</i> Dietz.	2767. <i>Acalles carinatus</i> Le Conte.
2717. <i>disjunctus</i> Le Conte.	2768. <i>sordidus</i> Le Conte.
2718. <i>subfasciatus</i> Le Conte.	2769. <i>claratus</i> Say.
2719. <i>robustus</i> Le Conte.	2770. <i>pectoralis</i> Le Conte.
2720. <i>moleculus</i> Casey.	2771. <i>crassulus</i> Le Conte.
2721. <i>ungularis</i> Le Conte.	2772. <i>Tyloderma foreolatum</i> Say.

¹ Two undetermined species.

LIST OF SPECIES—Continued.

2773. *Tuloderma fragariae* Riley.
 2774. *areum* Say.
 2775. *Phydrenus undatus* Le Conte.
 2776. *Cryptorhynchus parochus* Herbst.
 2777. *bisignatus* Say.
 2778. *fuscatus* Le Conte.
 2779. *obtusus* Herbst.
 2780. *fallax* Le Conte.
 2781. *minutissimus* Le Conte.
 2782. *tristis* Le Conte.
 2783. *ferratus* Say.
 2784. *Piazurus oculatus* Say.
 2785. *Copturus binotatus* Le Conte.
 2786. *nanulus* Le Conte.
 2787. *longulus* Le Conte.
 2788. *quercus* Say.
 2789. *minutus* Le Conte.
 2790. *Acoptus suturalis* Le Conte.
 2791. *Tachygonus lecontei* Gyllenhal.
 2792. *tardipes* Le Conte.
 2793. *Mononychus vulpeculus* Fabricius.
 2794. *Croponius inaequalis* Say.
 2795. *Acanthoscelis curtus* Say.
 2796. *acephalus* Say.
 2797. *tachygonoides* Dietz.
 2798. *Aulentes nebulosus* Le Conte.
 2799. *asper* Le Conte.
 2800. *Pelenosomus cristatus* Dietz.
 2801. *Acallodes ventricosus* Le Conte.
 2802. *Ceutorhynchus raperi* Gyllenhal.
 2803. *sulcipennis* Le Conte.
 2804. *pusio* Le Conte.
 2805. *atriculus* Dietz.
 2806. *anthonomoides* Dietz.
 2807. *squamatus* Le Conte.
 2808. *siculus* Dietz.
 2809. *erythropus* Dietz.
 2810. *septentrionalis* Gyllenhal.
 2811. *puberulus* Le Conte.
 2812. *zimmermanni* Gyllenhal.
 2813. *Cyclogaster zimmermanni* Gyllenhal.
 2814. *Perigaster cretura* Herbst.
 2815. *Pelenomus sulcicollis* Fabricius.
 2816. *Rhinoneus pericarpus* Linnaeus.
 2817. *pyrrhopus* Le Conte.
 2818. *longulus* Le Conte.
 2819. *Baris umbilicata* Le Conte.
 2820. *tumescens* Le Conte.
 2821. *subneca* Le Conte.
 2822. *Baris dolosa* Casey.
 2823. *confinis* Le Conte.
 2824. *discipula* Casey.
 2825. *Plesiobaris T-signum* Boheman.
 2826. *disjuncta* Casey.
 2827. *Glyptobaris rugicollis* Le Conte.
 2828. *Onychobaris pectorosa* Le Conte.
 2829. *Madarellus undulatus* Say.
 2830. *Aulobaris pusilla* Le Conte.
 2831. *scolopax* Say.
 2832. *Ampelogypter ater* Le Conte.
 2833. *longipennis* Casey.
 2834. *Desmoglyptus crenatus* Le Conte.
 2835. *Pseudobaris pectoralis* Le Conte.
 2836. *nigrina* Say.
 2837. *Trichobaris trinotata* Say.
 2838. *Centrinus picummus* Herbst.
 2839. *albotectus* Casey.
 2840. *perscillus* Gyllenhal.
 2841. *clarescens* Casey.
 2842. *perscitus* Herbst.
 2843. *penicillus* Herbst.
 2844. *scutellum-album* Say.
 2845. *Centrinopus alternatus* Casey.
 2846. *Nicentrus lincicollis* Boheman.
 2847. *Limnobaris braccata* Casey.
 2848. *limbifer* Casey.
 2849. *grisea* Le Conte.
 2850. *confusa* Boheman.
 2851. *confinis* Le Conte.
 2852. *concurrentis* Casey.
 2853. *cidea* Le Conte.
 2854. *Oligolochus convexus* Le Conte.
 2855. *Idiostethus tubulatus* Say.
 2856. *Stethobaris corpulenta* Le Conte.
 2857. *orata* Le Conte.
 2858. *Zaglyptus striatus* Le Conte.
 2859. *sulcatus* Le Conte.
 2860. *Oomorphidius laticollis* Le Conte.
 2861. *Barinus craticollis* Le Conte.
 2862. *curticollis* Casey.
 2863. *Barilepton filiforme* Le Conte.
 2864. *Plocamus hispidulus* Le Conte.
 2865. *Balaninus caryatipes* Boheman.
 2866. *quercus* Horn.
 2867. *uniformis* Le Conte.
 2868. *nasicus* Say.
 2869. *rectus* Say.
 BRENTHID.E.
 2870. *Eupsalis minuta* Drury.

LIST OF SPECIES—Continued.

CALANDRIDÆ.			
2871.	<i>Rhodobanus 13-punctatus</i> Illiger.	2916.	<i>Cryphalus rigidus</i> Le Conte.
2872.	<i>Sphenophorus ochreus</i> Le Conte.	2917.	<i>Ceocorypes dactyliperda</i> Fabricius.
2873.	<i>inæqualis</i> Say.	2918.	<i>Hypothencus eruditus</i> Westwood.
2874.	<i>perlinæ</i> Olivier.	2919.	<i>dissimilis</i> Zimmermann.
2875.	<i>cariosus</i> Olivier.	2920.	<i>Pityophthorus minutissimus</i> Zimmermann.
2876.	<i>sculptilis</i> Uhler.	2921.	<i>pullus</i> Zimmermann.
2877.	<i>zeæ</i> Walsh.	2922.	<i>pulicarius</i> Zimmermann.
2878.	<i>melanocephalus</i> Fabricius.	2923.	<i>puberulus</i> Le Conte.
2879.	<i>placidus</i> Say.	2924.	<i>annectens</i> Le Conte.
2880.	<i>parvulus</i> Gyllenhal.	2925.	<i>cousimilis</i> Le Conte.
2881.	<i>germari</i> Horn.	2926.	<i>hirticeps</i> Le Conte.
2882.	<i>Calandra oryzae</i> Linnaeus.	2927.	<i>Pityogenes plagiatu</i> s Le Conte.
2883.	<i>gramaria</i> Linnaeus.	2928.	<i>Xylocleptes decipiens</i> Le Conte.
2884.	<i>Dryophthorus corticalis</i> Say.	2929.	<i>Tomicus calligraphus</i> Germar.
2885.	<i>Himatium errans</i> Le Conte.	2930.	<i>cacographus</i> Le Conte.
2886.	<i>conicum</i> Le Conte.	2931.	<i>pini</i> Say.
2887.	<i>Cossonus impressifrons</i> Boheman.	2932.	<i>arculus</i> Eichhoff.
2888.	<i>Stenomimus pallidus</i> Boheman.	2933.	<i>calatus</i> Eichhoff.
2889.	<i>Phlecephagus apionides</i> Horn.	2934.	<i>Dryocates granicollis</i> Le Conte.
2890.	<i>minor</i> Horn.	2935.	<i>Micracis suturalis</i> Le Conte.
2891.	<i>Wollastonia quercicola</i> Boheman.	2936.	<i>opacicollis</i> Le Conte.
2892.	<i>Amaurorhinus nitens</i> Horn.	2937.	<i>rudis</i> Le Conte.
2893.	<i>Pentarthrus parvicollis</i> Casey.	2938.	<i>Thysanoes fimbriicornis</i> Le Conte.
2894.	<i>Heerathrum ulkei</i> Horn.	2939.	<i>Gnathotrichus materiarius</i> Fitch.
2895.	<i>Rhyncobus oregonensis</i> Horn.	2940.	<i>asperulus</i> Le Conte.
2896.	<i>Stenosectis brevis</i> Boheman.	2941.	<i>Xyleborus tachygraphus</i> Zimmermann.
SCOLYTIDÆ.		2942.	<i>dispar</i> Fabricius.
2897.	<i>Scolytus quadrispinosus</i> Say.	2943.	<i>celsus</i> Eichhoff, female.
2898.	<i>muticus</i> Say.		<i>biographus</i> Le Conte, male.
2899.	<i>rugulosus</i> Ratzeburg.	2944.	<i>fuscatus</i> Eichhoff, female.
2900.	<i>Chraucisus icoria</i> Le Conte.		<i>planicollis</i> Zimmermann, male.
2901.	<i>Phlaotribus liminaris</i> Harris.	2945.	<i>pubescens</i> Zimmermann, female.
2902.	<i>frontalis</i> Fabricius.		<i>retusicollis</i> Zimmermann, male.
2903.	<i>Hylesinus fasciatus</i> Le Conte.	2946.	<i>xylographus</i> Say.
2904.	<i>aculeatus</i> Say.	2947.	<i>Xyloterus scabricollis</i> Le Conte.
2905.	<i>opaculus</i> Le Conte.	2948.	<i>politus</i> Say.
2906.	<i>Cucsimus strigicollis</i> Le Conte.	2949.	<i>Corthylus punctatissimus</i> Zimmermann.
2907.	<i>Phloeosinus dentatus</i> Say.	2950.	<i>Monarthrum fasciatum</i> Say.
2908.	<i>Caryphoborus bifurcus</i> Zimmermann.	2951.	<i>mali</i> Fitch.
2909.	<i>Dendroctonus terebrans</i> Olivier.	2952.	<i>Platypus flavicornis</i> Fabricius.
2910.	<i>frontalis</i> Zimmermann.	2953.	<i>quadridentatus</i> Olivier.
2911.	<i>Hylastes porculus</i> Erichson.		
2912.	<i>carenosus</i> Zimmermann.		
2913.	<i>tenuis</i> Zimmermann.		
2914.	<i>Hylurgops pinifer</i> Fitch.		
2915.	<i>Crypturgus abutaceus</i> Schwarz.		

LIST OF SPECIES—Continued.

ANTHRIBIDÆ.

2954. *Eurygaster fasciatus* Olivier.
 2955. *Tropideres bimaculatus* Olivier.
 2956. *rectus* Le Conte.
 2957. *Horniscus saltator* Le Conte.
 2958. *Torotropis pusillus* Le Conte.
 2959. *fasciatus* Le Conte.
 2960. *Eusphyrus walshii* Le Conte.
 2961. *Piezocorynus dispar* Gyllenhal.
 2962. *maestus* Le Conte.
 2963. *mixtus* Le Conte.
 2964. *Anthrribus cornutus* Say.
 2965. *Cratoparis lunatus* Fabricius.
 2966. *lugubris* Olivier.
 2967. *Brachytarsus alternatus* Say.
 2968. *limbatus* Say.
 2969. *tomentosus* Say.
 2970. *variegatus* Say.
 2971. *Anthrribulus rotundatus* Le Conte.
 2972. *Choragus zimmermanni* Le Conte.
 2973. *sugi* Le Conte.
 2974. *nitens* Le Conte.
 2975. *Euxenus punctatus* Le Conte.

ECOLOGICAL NOTES.

CICINDELIDÆ.

Tetracha virginica, not common; single specimens have been found at various places.

Cicindela rugifrons, on the hills near Bennings Station, not rare many years ago, but not found again; *sexguttata*, common in the woods in early spring; *purpurea*, rare; *vulgaris* and *repanda*, common everywhere on open sandy places, especially near water; *hirticollis* and *marginata*, on sand banks of the lower Potomac, where the water begins to be brackish; *punctulata*, our commonest species, abundant in the streets and attracted by electric lights; *rufiventris*, not rare in the fall, across the Free Bridge, also found at Bladensburg

CARABIDÆ.

Omophron labiatum, hitherto only found at electric lights in June; *americanum*, common along the Potomac and Eastern Branch.

Cychrus stenostomus, in woods at various places during the whole year; *elevatus*, like *stenostomus*, not common; *unicolor*, across the Free Bridge, not rare in former years; *viduus*, found only once near Chain Bridge.

Carabus. All species are found in woods at various places; *limbatus*, very common; *sylvosus*, rather rare.

Calosoma. All species are extremely abundant at electric lights, but not commonly found elsewhere.

Elaphrus riparius and *ruscarius*, on mud banks along streams.

Notophilus. The species are common in dry woods under old leaves.

Nebria pallipes, common along water courses.

Pasiuachus depressus, rather common under stones and logs in dry places; *sublavis*, the same, but rare.

Scarites subterraneus, very common everywhere under stones in the ground.

Dyschirius globulosus, common under leaves in rather wet places; *hemorrhoidalis*, near pools of stagnant water; *sphaericollis*, along the Potomac; *pumilus* and *pilosus*, the same.

Clivina punctigera, only a few specimens were found at electric lights; *planicollis*, rare; all the other species are common along the Potomac and Eastern Branch, under stones in moist places.

Aspidoglossa subangulata, along the Potomac, not common, but more abundantly found at electric lights.

Schizogenius, abundant along streams.

Ardistomis obliquata, not common, on the Eastern Branch, near Bennings; *viridis*, very abundant along the Potomac.

Panageus fasciatus, on grassy hills under flat stones, not uncommon at electric lights.

Bembidium punctatostriatum. This and all the other species occur along the water courses, especially on sandy and pebbly places.

Anillus fortis, our only blind Carabid, found under deeply interred stones.

ECOLOGICAL NOTES—Continued.

- Tachys*. All the species occur abundantly along streams, except *nanus* and *flavicauda*, which are common under bark of decaying logs.
- Pericompsus ephippiatus*, along the shore of the Potomac.
- Patrobis longicornis*, common with *Nebria pallipes*.
- Myas coracinus*, two specimens found some years ago in the woods near Mount Pleasant.
- Pterostichus*. The species are more or less common in the woods. Among the less common species are *ebenus*, *diligendus*, *rotundatus*, *approximatus*, and *gravis* of which only two specimens were found.
- Ecurthus*, like *Pterostichus*, rather rare.
- Amara*, found more or less common everywhere, in woods, on hills, along streams, etc.; only *crassispina* and *cupreolata* are less frequent.
- Loxandrus*, common on swampy places across the Free Bridge.
- Diplochila laticollis*, not very common along the river.
- Dicelus*, not rare under stones and logs.
- Budister notatus* and *reflexus* common in moist places under old leaves; *flavipes*, very rare; *pulchellus* and *maculatus* found only at electric lights; only two specimens of the latter have been found.
- Calathus*, very common everywhere.
- Platypus caudatus*, very rare in moist places in spring; *picicornis*, only one specimen found at electric light; *sinuatus*, not rare under loose bark of trees; the others are all more or less common under old rubbish along the streams.
- Olisthopus parvatus*, common; *micans*, rare.
- Perigona*, both species found once gregariously in moist places.
- Atranes pubescens*, very common under old leaves in moist grounds.
- Leptotrachelus dorsalis*, not common.
- Casnonia pennsylvanica*, extremely common; *ludoviciana*, apparently not rare in swamps near Eastern Branch.
- Galerita janus*, very common; *bicolor*, less common.
- Thalpius dorsalis*, a single specimen at electric light.
- Tetragonoderus fasciatus*, common on dry sand banks along streams.
- Nemotarsus elegans*, very rare; once found at High Island.
- Lebia*, more or less common on flowers, under stones, chips, and old leaves; *marginicollis*, *pleuritica*, *fusca*, and *abdominalis*, rather rare.
- Coptodera acrata*, common on stumps and logs.
- Dromius piceus*, under bark, common.
- Apristus subsulcatus*, common on sand banks near the river; *cordicollis*, one specimen.
- Blechnus pusio*, amongst the roots of grasses in dry meadows.
- Metabletus americanus*, near the District in Maryland.
- Plochionus timidus*, rare, beaten from trees.
- Pinacodera limbata*, common; *platycollis*, rather rare.
- Cyprinidis pilosa* and *neglecta*, very common, under stones in dry localities; *americana*, less common; *elegans*, very rare.
- Apeus lucidula*, not common; *sinuata*, more frequent.
- Helluomorpha bicolor* and *nigripennis*, both rare.
- Brachynus*. All species of this genus are more or less common, and their specific value is by no means established.
- Chlanius leucoscelis* and *prasinus* are on river banks; *niger* sometimes at electric lights; the other species are common everywhere.
- Brachylobus lithophilus*, like *Chlanius prasinus*.
- Lachnocrepis parallelus*, rather rare in swampy places.
- Anatrichis immuta*, only a single specimen found.
- Oodes amaroides*, found in very wet places, not common; *americanus*, the same, very common.
- Erolenes exaratus*, several specimens found, very rare.
- Geopinus incrassatus*, not rare, but found by hundreds at electric lights.

ECOLOGICAL NOTES—Continued.

Cratacanthus dubius, one of our most common Carabids.

Agonoderus. All species of this genus are common, except *indistinctus*, *testaceus*, and *micrus*.

Discoderus tenebrosus, very rare.

Gynandropus hylacis, very common.

Harpalus caliginosus, extremely abundant, especially at electric lights in midsummer; all the other species are more or less common everywhere.

Selenophorus pedicularius. This and the other species are common; especially at electric lights.

Stenotopus, common on wet places, except *alternans*, which is very rare on mud banks near the Potomac.

Acupalpus, like *Stenotopus*.

Bradycellus linearis, many specimens of this rare species found near swampy places in spring; the other species are common in moist grounds.

Tachycellus, common, like *Stenotopus*.

Anisodactylus discoidens and *baltimorensis*, abundant along the rivers and at electric lights; *latus* rather rare; the remaining species are common everywhere.

Xestonotus lugubris, not common, along the river.

Anaphasia interstitialis, very common.

Anisotarsus terminatus, common; *nitidipennis*, less common.

Spongopus verticalis, rare.

HALIPLIDÆ.

Haliphus triopsis, common in ponds of stagnant water; *punctatus*, rare; *ruficollis*, one specimen found.

Cnemidotus simplex and *12 punctatus*, in ponds of stagnant water.

DYTISCIDÆ.

Canthydrus and *Hydrocathus*, abundant in stagnant water.

Laccophilus, common in ponds and flowing water.

Hydrovatus and *Desmopachria*, abundant in stagnant water.

Bidessus, common, except *flavicollis* and *granarius*.

Celina angustata, very common in pools on the Potomac Flats.

Calambus nubilis, common, *dissimilis*, one specimen.

Hydroporus, all the species are more or less common in brooks and creeks; *oblitus*, in cold springs.

Hybius biguttatus, very common, especially at the electric lights.

Coptotomus and *Copelatus*, abundant.

Matus bicarinatus, not common.

Agabetes acinuctus, rare.

Agabus erythropterus, rare in springs; the rest more or less common.

Rhantus calidus, two specimens at electric light.

Hydaticus bimarginatus, few specimens at electric light.

Dytiscus hybridus, rare.

Acilus mediatus, not rare.

Thermonectes basilaris, very abundant, especially at electric lights; *ornaticollis*, rare.

Graphoderus liberus, rare.

Cybister fimbriolatus, common in ponds.

GYRINIDÆ.

Dinectes, more or less abundant in schools in stagnant and running waters.

Gyrinus, like *Dinectes*.

Hedophorus lineatus, in ponds, common; *inquinatus*, less common.

Hydrochus subcupreus, very abundant in ponds; *seabratus* and *inæqualis*, not common.

Hydranus pennsylvanica, extremely abundant.

Hydrophilus triangularis, very abundant at electric lights; also *oratus*, but less abundant.

Tropisternus and *Hydrocharis*, common at electric lights.

Berosus peregrinus and *striatus*, very common; *erigius*, rare.

Laccobius agilis, extremely abundant everywhere.

Philhydrus, all common, except *perplexus*.

Helochaers maculicollis, common.

Helocombus bifidus, rare.

Cymbiodyta fimbriata, not rare; *blanchardi*, rare.

ECOLOGICAL NOTES—Continued.

- Hydrobius tessellatus*, very rare; the others common.
- Creniphilus subcupreus*, very abundant in running water.
- Phaenonotum exstriatum*, in swamps.
- Cercyon unipunctatus*, in horse dung; *praetextatus*, in dung and decaying plants; *indistinctus*, one specimen; *haemorrhoidalis*, in fungi; also *varicularis* and *pubescens*; the rest are more or less common in rotten vegetable matter.
- Cryptopleurum minutum*, common; *americanum*, very rare.
- Penelus costatus*, very rare in rotten fungi.

LEPTINIDÆ.

- Leptinus testaceus*, in the nests of wood mice (*Arvicola*), in different localities.

SILPHIDÆ.

- Necrophorus americanus*, on dead snakes; also at electric lights; the others are found on various dead animals.
- Silpha surinamensis*, very abundant, especially at electric lights; this and the others are found on putrid matters; common.
- Pinodytes cryptophagoides*, blind, under decayed leaves in rather moist places. This species, in company with *Eutyphlus similis* and *Anillus fortis*, both blind, is frequently found in the mountains of Virginia.
- Cholera*. All the species are found under old leaves, in fungi, and on dead animals.
- Prionochata opaca*, like *Cholera*.
- Ptomaphagus ulkei*, only two specimens were found under decayed leaves, across the Free Bridge; *parasitus*, in the nests of *Formica integra*.
- Colo*. Of *paradoxum*, *hubbardi*, *thoracicum*, and *asperatum*, only single specimens have been found.
- Anisotoma obsoleta*, not rare; of *alternata* and *assimilis* only single specimens; species of this genus are to be found either under old leaves or in beating meadows at sunset in early summer.
- Colenis impunctata*, very common in fungi and under old leaves.

- Liodes*. All live in rotten wood, permeated with fungus growth.
- Cyrtusa*, beaten from grass on warm summer evenings, common.
- Isoplastus fossor*, like *Cyrtusa*, but rare.
- Agathidium*, in rotten wood and under old bark.
- Aglyptus levis*, like *Agathidium*.
- Clambus gibbulus*, under flood débris; *puberulus*, less common.

SCYDMENIDÆ.

- Cheerolatia amena*, sifted from old leaves, very rare.
- Brachycerepis*, not rare, under old leaves.
- Seydmanius rufus*, under bark of old stumps, always in company with *Lasius alienus*; all the other species occur under old leaves in damp places.
- Eumierus motschulskii*, very abundant; *grossus*, rather rare.
- Cholerus zimmermanni*, rather rare.
- Cephennium corporosum*, not rare under old leaves.

PSELAPHIDÆ.

- Adranes lecontei*, very rare, with *Lasius claviger*.
- Ceophyllus monilis*, rare, under bark of rotten trees.
- Cedius zieglerei*, common in the hills of *Formica integra* and *exsectoides*; *spinuosus*, under loose bark of old trees.
- Tmesiphorus*, like *Ceophyllus*.
- Cheumatium monilicornis*, very rare, with *Psenolepis parvula*.
- Ctenistes*, all the species are abundant under old leaves.
- Tyrus humeralis*, rare, under bark of old trees.
- Pselaphus erichsonii*, one specimen under a stone near Woodley Park.
- Tychus longipalpus* and *minor*, both frequently found under old leaves in rather dry places.
- Entrichites zimmermanni*, rare.
- Nisarix tomentosa*, rare.
- Decarthron stigmatosum* with *Aphaenogaster treati*; *exsectum*, one specimen found; the rest by sifting old leaves and sweeping meadow grass at sunset.

ECOLOGICAL NOTES—Continued.

Bryaxis, most all of the species are found by beating grassy places toward sunset in the early part of June; *valida*, two specimens, near Free Bridge; *belfragei*, two specimens; *gemmifer*, one specimen.

Arthmius globicollis, exceedingly abundant under old leaves in moist places.

Batrissus ioux, rare, with *Lasius alienus*; *monstrosus* and *ferox* occur with *Lasius claviger* and *interjectus*; *nigricans* and *triangulifer*, only single specimens; *globosus*, very common.

Trimium, sifted from decayed roots in the grounds, also beaten from grasses at sunset.

Rhevidius canaliculatus, one specimen.

Rhexius insculptus, taken abundantly by sweeping.

Thesium cavifrons, two specimens.

Trinipectus arcuatus, one specimen.

Euplectus, generally found in rotten wood.

Eutyphlus similis, very common with *Pisodytes cryptophagoides*.

STAPHYLINIDÆ.

Aleochara lata, common under carcasses; the others very common under dung.

Oxyptoda sagulata, excessively common; most of the species are common under dung; several undescribed species.

Xenodusa cara, found in the nests of *Camponotus pennsylvanicus*.

Myrmecodia rudis, very rare; *schwarzi*, in the nests of *Lasius alienus*.

Philothermes pennsylvanicus, among *Termes*, not rare.

Hoplandria lateralis, very common under old leaves and carcasses.

Atheta, most of the species remain undetermined.

Tachyusa, like *Atheta*.

Fidaglia bilobata, this and the other species are more or less abundant under old leaves.

Euryusa obtusa, not rare in the nests of *Formica integra* and *exsectoides*.

Leptusa, the species are common under moist bark.

Placusa, like *Leptusa*.

Gyrophæna, all species live in toadstools.

Myllæna and *Dinopsis*, in old moist leaves and flood débris. Several genera

and a great number of species of the *Aleocharinæ* remain as yet unrecognized and undescribed.

Acylophorus flavicollis and *pronus*, common under débris near water; *densus*, very rare.

Heterothops pusio, not rare.

Quediüs ferox, rather rare; the others are abundant under old leaves, stones, etc.

Listrotrophus cingulatus, very common under decaying vegetable and animal matter.

Creophilus villosus, like the preceding.

Staphylinus vulpinus, under old leaves, common; *maculosus*, in decaying fungi, dung; *fossator*, decaying fungi; *violaceus*, very abundant in old fungi; *comes*, *cutans*, both rare under dung; *prelongus* and *viridans*, each one specimen.

Ocyppus ater, rare under stones.

Belonuchus formosus, very abundant on sap exuding from wounded trees.

Tympanophorus puncticollis, very rare.

Philonthus politus, rare; *unbratilis*, *letulus*, *inquietus*, each one specimen; *asper*, not rare in the stems of toadstools; *hepaticus*, very abundant under dry leaves; *umbrius*, under old leaves near the river; most of the other species are more or less abundant under old dung or decaying fungi.

Actobius cinerascens, under débris along the river, common; also *sobrius* and *pæderoides*, very abundant; of *procerulus*, *parvus*, *terminalis* and *lepidulus*, single specimens.

Xantholinus fulgidus and *temporalis*, rare; *cephalus*, under bark of trees; *emmesus*, abundant under bark and old leaves; *humatus*, common under decaying weeds.

Leptolinus rubripennis, not rare in débris along the river.

Leptacinus, all very common under old leaves.

Diochus schaumii, common everywhere.

Stenus. Most species of this genus live on sand banks near streams, some of them gregariously in great numbers; of *delawarensis* only found two specimens under débris on the Potomac Flats, and *dispar*, on the hills across the Free Bridge.

ECOLOGICAL NOTES—Continued.

- Eucyrtetus americanus*, under moist leaves.
Edaphus nitidus, under moldy leaves.
Stictocranium puncticeps, under old leaves, but not common.
Cryptobium bicolor, *pallipes*, *carolinum*, common in swampy places near the river; *badium* and *cribratum*, rather rare; *serpentinum* and *flavicornis*, very rare.
Lathrobium, all very common under old leaves, except *armatum*, *simile* and *ambiguum*.
Scopasus, like *Lathrobium*, common.
Stilicus tristis and *biarmatus*, rare; *dentatus*, common in fungi.
Lithocharis ochracea, rather common.
Aderocharis corticina, very common under moist old leaves.
Trachysectus confluentis, under moist bark of old trees, abundant.
Pederus littorarius, very abundant everywhere.
Sunius, like *Pederus*.
Echiaster (*Leptogenius*), an apparently undescribed species, not rare under old leaves.
Stilicopsis monstrosa, common; *paradoxa*, very rare.
Pinoophilus latipes, not rare under stones; *picipes*, one specimen.
Palaminus testaceus, common; *contortus*, rare.
Microcyptus testaceus, one specimen among termites.
Tachinus memnonius, *luridus*, *flavidus*, *fimbriatus*, *pallipes*, in fungi; *funipennis*, common in dung; *repandus*, *limbatus*, and *nitiduloides* under old leaves.
Tachyporus, all under old leaves and stones; *maculipennis*, rare.
Citea silphoides, very abundant in horse manure.
Erechomus ventriculus, abundant under moist old bark; *lavis*, under old leaves.
Conosoma. All the species of this genus live under old leaves or on fungi growing on dead trees.
Bolitobius, more or less common in fungi.
Bryoporus rufescens, very abundant under old leaves; *flavipes*, two specimens.
Mycetoporus, all species occur under old leaves.
- Megalops exaltatus*, very rare, on fungi growing under logs.
Oryzoporus, all the species live exclusively in toadstools.
Oserius latipes, not rare, burrowing in the ground under stones.
Holotrochus laricauda, rather rare.
Bledius. These species live on mud or sand banks near the river.
Platystethus americanus, exceedingly common in dung.
Oryctelus. These species, with the exception of *placasinus*, which is myrmecophilous, live either in dung or decaying vegetation.
Trogophleus, all live on mud banks or in decaying leaves in muddy swamps.
Apocellus sphericollis, very common under stones, everywhere.
Aucyrophorus, found on stones in a small creek near Cabin John Bridge.
Thinobius fimbriatus, on gravel banks near the Eastern Branch.
Geodromicus casus and *Lestera pallipes*, common along water courses.
Acidota subcarinata, not rare under leaves in the fall.
Arpedium schwarzi, very abundant under old leaves.
Olophrum, like *Arpedium*.
Homidium humerosum and *repandum*, common under old leaves; *diffusum*, in fungi; *fractum*, under moist bark; *hamatum*, on dry leaves of felled trees.
Anthobium convexum, very abundant on flowers in early spring.
Ephelis notata, very common; *guttata*, rare.
Protinus atomarius, very common under old leaves.
Megarthus americanus, in fungi, not common.
Lispinus exiguus, one specimen under bark.
Glyptoma costale, in decaying wood, very common.
Triga picipennis, under bark of various trees.
Eleusis pallidus, found once in great numbers under the bark of an old stump.
Stagonium americanum, one specimen.
Micropeplus cribratus, one specimen.

ECOLOGICAL NOTES—Continued.

TRICHOPTERYGIDÆ.

Nossidium americanum, found once very abundantly in a much decayed old stump.

Ptilium and *Ptenidium*. Species of these genera occur under old leaves in moist places.

Limulodes paradoxus, strictly myrmecophilous, among *Lasius claviger*.

Pteryx batteata, in decaying wood.

Ptenelloides lecontei, under old leaves.

Trichopteryx. These species are more or less abundant in all sorts of decayed vegetable matters; several undescribed species.

Smicrus filicornis, under débris near water.

Ptinella quercus and *pini*, under moist bark.

Nephanes leviusculus, under old leaves.

SCAPHIDIIDÆ.

Scaphidium obliteratum, on the mold-like fungus growing on the underside of logs, rather rare; *quadriguttatum*, with the preceding, abundant.

Cyparium and *Brocera* on moldy old leaves.

Toxidium gammaroides, lives like the next.

Scaphisoma, live in fungi and old leaves.

PHALACRIDÆ.

Phalacrus, *Otilrus*, *Litochrus*. All our Phalacridæ occur on various plants, as well as under decaying leaves.

CORYLOPHIDÆ.

Sacium, our species live under bark of various trees; can also be beaten from dead branches.

Arthrolips, *Scricoderus*, under old leaves.

Orthoperus glaber, very abundant on growing vegetation.

COCCINELLIDÆ.

Anisosticta seriata, one specimen; more abundant near salt-water regions.

Megilla maculata, a very abundant species, gregariously under bark and stones in cold weather.

Hippodamia 13-punctata, one specimen; the other species are common.

Coccinella affinis, on pine trees in early spring, on willows in summer; the other species are common.

Adalia bipunctata, abundant in our parks and gardens.

Harmonia picta, rare, on pine trees.

Mysia pullata, exclusively on pine trees.

Anatis ocellata, very abundant everywhere.

Psyllobora 20-maculata, very common on low vegetation.

Chilocorus birubernus, exceedingly abundant.

Ecochomus 3-pustulatus, on oaks, not common.

Cryptognatha pusilla, on shrubbery, very abundant.

Smilia marginata and *miscella*, on trees and shrubs, common.

Brachyacantha. The various species are beaten from low plants in meadows.

Hyperaspis. All the species are beaten from trees and shrubs.

Seymus. All species live on trees, shrubs, and low plants.

Cephaloseymus zimmermanni, on branches, very rare.

Epilachna borealis, very common, feeds on cucurbitaceous plants.

ENDOMYCHIDÆ.

Alexia lobata, a single specimen.

Anomorphus spec.? known in our collections as *A. pusillus* Zimmermann Mss.

Symbiotes ulkei and *minor*, live on mold growing within red rotten logs.

Mycetva hirta, on molds in dark places.

Rhanis unicolor, very abundant under old bark.

Liestes spec.? very rare, at the base of trees.

Phymaphora pulchella, under old bark.

Lycoperdina ferruginea, in a small species of *Lycoperdon*.

Aphorista vittata, on molds on logs, common.

Mycetina testacea, on fungi growing on roots and logs; *perpulchra*, rare, on mold under bark.

Stenotarsus hispidus, on dead branches of various trees.

ECOLOGICAL NOTES—Continued.

Endomychus biguttatus, sometimes in great numbers under loose bark.

EROTYLIDÆ.

Languria. Our species are most frequently found on swampy meadows; *mazardi*, the most common species.

Eucyrtus punctatus, under old bark infested with fungi.

Ducne 4-maculata, on white fungi, growing on old logs.

Megaloducne, like *Eucyrtus*.

Ischyrops 4-punctatus, in company with *Ducne*.

Mycotretus sanguinipennis and *pulcher*, in a certain kind of toadstool.

Tritoma. All species live usually in large numbers in toadstools and various fungi.

COLYDIIDÆ.

Synchita obscura, found exclusively on red oak; the other species occur under bark of dead branches of various deciduous trees.

Cicones marginalis, one specimen.

Ditoma. The species are found under bark of all sorts of trees.

Coxelus guttulatus, not rare on dead branches.

Lasconotus referendarius, under pine bark in the galleries of Scolytids.

Aulonium and *Colydium*, the species of both genera are found under bark and in twigs of coniferous and deciduous trees.

Agleus brunneus, introduced from Europe; one specimen found by Mr. Pergande.

Oxykennus americanus, rare.

Penhelispa and *Pycnomerus*, under moist bark of dead pines.

Bothrideres geninatus, very common under dry oak bark.

Erotylathris exaratus, very rare.

Cerylon castaneum, under all sorts of bark, very abundant.

Philothermus glabriculus, very common in decayed wood.

MURMIDIIDÆ.

Murmidius oralis, introduced, in old stored rice.

Mychocercus depressus, under moldy bark.

RHYSSODIDÆ.

Rhyssodes and *Clividium*, both genera found under bark of decayed wood.

CUCUJIDÆ.

Silvanus surinamensis and *adema*, cosmopolitan, common; the others under all sorts of bark.

Nausibius claricornis, under bark, rare; *repandus*, very rare.

Catogenus rufus, very common under bark of various trees.

Pediacus depressus, under bark, rare.

Cucujus claripes, very common under bark of deciduous trees, especially *Liriodendron*.

Ito reclusa, under bark of black locust.

Lamophlaccus, species more or less common under bark of various deciduous trees; *schwarzii*, very rare; *angustulus*, in galleries of Scolytids.

Lathropus cernalis, very common on old twigs.

Dysuermus basalis, in branches of *Rhus toxicodendron*, common at Bladensburg.

Brontes dubius, under bark, abundant; *debilis*, one specimen.

Telephanus velox, under old leaves, one of our commonest insects.

CRYPTOPHAGIDÆ.

Telmatophilus and *Loberus*, by sweeping humid meadows.

Tomarus pulchellus, under old leaves, chips, etc., very common.

Antherophagus ochraceus, rare, on flowers, inquilinous in nests of *Bombus*.

Henoticus serratus, the specimens found here may belong to a distinct species, rare.

Cryptophagus. Six species occur in the District, which have not yet been studied.

Cænoscelis. There are seven species found here, which can not be named at present; they occur under old leaves.

Atomaria ephippiata, *distincta*, and *ochracea*. Eight species have been found, among which only these three are named at present.

Ephistemus apicalis, very common under old leaves and chips.

ECOLOGICAL NOTES—Continued.

MYCETOPHAGIDÆ.

Mycetophagus punctatus and *flexuosus*, very common in various fungi; *obsoletus*, once found in abundance in a white fungus; *pluripunctatus*, in fungi under moldy bark; *bipustulatus*, in old flour barrels, also on moldy bark; *pini*, under old pine bark; *melsheimeri*, one specimen.

Litargus. All our species are common under decomposing vegetable matter, also under bark.

Typlicea fumata, like *Litargus*, very common.

Bergius pumilus, one specimen.

Mymecheiveneus lathridioides, in old horse manure, in autumn.

Diplocelus brunneus and *rudis*, old branches infested with fungi.

DERMESTIDÆ.

Byturus unicolor, commonly found by beating.

Dermestes caninus, common under carcasses; *lardarius*, common in houses; *culpini*, under old bones; *elongatus*, one specimen found under bark.

Attugenus piccus, abundant, especially in houses; *pellio*, one specimen; *hornii*, introduced from Mexico.

Trogoderma and *Antrenus*, our common house and cabinet pests, also common outdoors on flowers, especially *Spiræa*.

Cryptorhopalum hæmorrhoidale and *triste*, very abundant on flowers.

Apsectus hispidus, one specimen.

Orphilus niger, on flowers, rare.

HISTERIDÆ.

Hololepta. The two species are not rare under freshly loosened bark of trees.

Hister. All our species of the genus *Hister* occur in vegetable débris, except the subgenera *Platysoma* and *Cylistix*, the species of which live under bark of deciduous or coniferous trees; *Phelister æneomicans* is very rare and seems to have not been found elsewhere.

Tribalister marginellus, very rare; only a few specimens have been caught, flying about in early spring.

Tribalus americanus, not rare, under bark and in decaying wood.

Epicrus, like *Tribalus*.

Heterius brunneipennis, in nests of *Formica fusca*.

Echinodes setiger, only one specimen found. *Orthophilus alternatus*, under fungus or vegetable débris.

Dendrophilus punctulatus, not rare under bark of old trees.

Puromalus. Our species are more or less abundant under old bark of trees.

Anapleus marginatus, under old boards and sticks on the banks of the river.

Saprinus. Of these species *fraternus*, *fitchii*, and *patruelis* are found in sand near the river; all the others occur in various kinds of dung.

Plegaderus transversus, in galleries of *Tomiscus* under pine bark.

Teretrius, *Bacanius*, and *Acritus*. All species of these genera live under bark of trees.

NITIDULIDÆ.

Brachypterus urtica, on nettles.

Cercus abdominalis, on flowers of *Sambucus niger*.

Carpophilus hemipterus, found in grocery stores; the others live on blossoms and sap of trees.

Colastus. All on exuding sap of trees.

Conotelus obscurus, on flowers of *Convolvulus*; *mexicanus* is introduced into greenhouses.

Eparcea peltoides, rare, on sap of trees; all the others are found under old leaves.

Nitidula, common under dry carcass.

Stelidota, under dry leaves.

Prometopia 6-maculata, on sap of trees, common.

Phenolia grossa, in fungi, common.

Omosita colon, under dry animal matter, abundant.

Amphotis ulkei, in ants' nests.

Soronia undulata and *substriata*, on sap of trees, common.

Thalycra concolor, one specimen.

Pocadius helvolus, in *Lycopodon*, very common.

Orycnemus, in fungi.

Amphicrossus ciliatus, on sap of trees.

ECOLOGICAL NOTES—(Continued).

Pallodes pallidus, in toadstools, abundant.
Cybebarium adustus, in fungus.
Cybocephalus nigritulus, on twigs of trees.
Cryptarcha and *Ips*. The species of both genera found on sap.
Pityophagus cephalotes, one specimen on a fence, south of the Treasury.
Rhizophagus, on mold under bark.

LATHRIDIIDÆ.

Holoparamesus kunzei, one specimen found under bark of an old hickory tree.
Lathridius liratus, very common under débris.
Enicmus and *Coninomus*, found on molds.
Corticaria and *Melanophthalmus*, found by sifting and beating.

TROGOSITIDÆ.

Nemosoma parallelum and *cylindricum*, parasitic on Scolytids.
Alindria cylindrica and *teres*, on old branches.
Trogosita virescens, very common under various trees.
Tenebrioides mauritanica, in flour and feed stores; the other species found under bark of trees.
Grynocharis quadrilineata, rare, on tree fungi.
Lycoptus villosus, in decaying wood.
Thymalus fulgidus, on tree fungi.

MONOTOMIDÆ.

Monotoma, under decaying weeds.
Hesperobanus, *Evrops*, and *Bactridium*, under bark of trees.

BYRRHIDÆ.

Nosodendron unicolor, sap of trees.
Byrrhus murinus, in moss.
Syncalyptra strigosa, sifted from moss.
Linnichus, along the edge of the river.

PARNIDÆ.

Psephenus lecontei, under stones in running water.
Lutrochus luteus, two specimens swept along the river.

Dryops, under stones and débris in running water.
Elmis, under stones and moss in running creeks.
Stenchnis, *Macronychus*, and *Ancyronyx*, like *Elmis*.

HETEROCERIDÆ.

Heterocerus. All the species occur in mud and sand banks.

DASCYLLIDÆ.

Eurygogon niger and *californicus*, on bushes.
Odontonyx and *Anchytarsus*, in swampy places.
Ptilodactyla serricollis, on bushes and low plants.
Eucinetus, sifted from moldy leaves.
Ectopria nervosa, on plants.
Prionocyphon, *Helodes*, *Scyrtes*, and *Cyphon*.
 All the species of these genera live on plants in swampy places.

RHIPICERIDÆ.

Zenopsis picea, under bark of trees.
Sandalus, occasionally found.

ELATERIDÆ.

Melasis pectinicornis, found boring in dead oak.
Tharops ruficornis, boring in felled trees.
Deltometopus, on bushes, common.
Dromæolus, boring from dead branches.
Forma, like *Dromæolus*, but rare.
Aldrothyreus dejeanii, one specimen.
Microrhagus, all on dead branches.
Hypocæcus, like *Microrhagus*.
Adelocera, all under loose bark.
Meristhus scobinula, one specimen in a sandy place near Rock Creek.
Chalcolepidius viridipilis, on fences and trees.
Alaus oculatus, under bark of various trees; *myops*, under bark of pine trees.
Hemirhipus fascicularis, on fences and trees.
Cardiophorus convevus and *gagates*, beating from trees and bushes; *cardisce*, on sandy places.

ECOLOGICAL NOTES—Continued.

Horistonotus curiatus, on bushes and trees, common.

Esthesopus claricollis, one specimen.

Cryptohypnus choris, on dry sand banks; *melshiemeri* and *perplexus*, on gravel banks; the others swept in meadows.

Anchastus rufus, very rare.

Monocephidius, on meadows and bushes; *auritus* and *bellus* very common under stones in early spring.

Dicrepidius and *Ischiodontus*, both very rare, on bushes.

Elater. All the species are found under bark and by beating dead branches.

Drasterius elegans and *amabilis*, mostly under stones, very abundant.

Megapenthes, on bushes.

Ludius, under bark.

Agristes and *Dolopius*, on bushes.

Glyphonyx, on bushes, very common.

Melanotus, *Limonium*, *Athous*, *Sericosomus*, *Corymbites*, *Hemicrepidius*, and *Melanaetes* are all more or less frequent in old stumps, under bark and stones, or beaten from various bushes; *Leptoschema bicolor* is very rare; *Sericosomus viridanus*, under chips and stones in early spring; *Melanaetes reichei*, only two specimens.

Perothops mucida, from old beech trees.

Cerophytum pulsator, three specimens found under chips and stones in early spring.

THROSCIDÆ.

Drapetes geminatus, under rotten bark and on dead branches.

Aulonothroscus and *Throscus*, under old leaves and plants.

BUPRESTIDÆ.

Chalcophora virginiana, in pines; *campestris*, on sycamore.

Dicerea, on various deciduous trees.

Pædonota debilis, very rare.

Buprestis rufipes, on oak; the other species on pines.

Cinyra gracilipes, on oak.

Melanophila, all on pines.

Anthaxia, all on various deciduous trees.

Chrysobothris femorata, *pusilla*, *azurea*, and *scitula*, on various deciduous trees; *floricola*, *dentipes*, *6-signata*, *harrisii*, on pines.

Aetenodes acornis, rare.

Acanxodera ornata and *culta* on flowers.

Posima gibbicollis, on black locust.

Mastogenius, on oaks.

Eupristocerus cogitans, on elder bushes.

Agrilus ruficollis, on different kinds of

Rubus; *otiosus*, on oak and hickory;

arcuatus, on hazel; *bilineatus*, on chest-

nut and honey locust; *politus*, on oak;

eugenus, on black locust; *obsoletus* and

granulatus are rare.

Rhabdoscelis tenuis, on oaks.

Taphrocercus gracilis, very common on plants in swampy meadows.

Brachys, all on oak bushes.

Pachyscelus purpureus. The larva mines the leaves of *Lespedeza*.

LAMPYRIDÆ.

Calopteron terminale and *reticulatum*, both common.

Celetes basalis, not common.

Cenia dimidiata, rare.

Eros, *Plateros*, and *Calochromus*, on flowers and bushes.

Lucidota, like the preceding.

Ellychnia corrusca, very common about trees and bushes.

Pyropyga and *Pyractomena*, like *Ellychnia*.

Photinus pyralis, our commonest firefly.

Photuris pennsylvanica, very abundant.

Phengodes spec.?, a single female specimen has been found.

Tytlhonyx erythrocephala, common on bushes.

Omethes marginatus, rare, beaten from bushes.

Chauliognathus, very common on blossoms and flowers.

Podabrus tricoloratus and *basilaris*, rare; the others common.

Silis percomis and *spathulata* are both rare.

Ditennus bidentatus, very common on clover.

Telephorus. All species are on low plants and bushes.

Polemnius laticornis, on meadows.

Tryptherus latipennis, common on bushes.

Malthinus and *Malthodes*, on bushes and grasses in meadows.

ECOLOGICAL NOTES—Continued.

MALACHIIDÆ.

- Collops*, more or less common in meadows, chiefly on clover.
Chytocaelus setosus, on branches of oak.
Anthocomus Pseudebeus, and *Attalus*. All the species of these genera are found on grasses, flowers, and bushes.

MELYRIDÆ.

- Almyris cribrata*, chiefly found on chestnut blossoms.

CLERIDÆ.

- Elasmocerus terminatus*, found on trees infested with Scolytids and Bostrychids.
Cymatodera, on dead branches.
Trichodes apivorus, on flowers of Spirea.
Clerus quadricuttatus, on pine; *rosmarus*, on flowers; *ichneumonens* and *thoracicus*, on branches of deciduous trees.
Thanasimus dubius, on pine.
Thaenoclerus sanguineus, under bark of deciduous trees; *tantillus*, one single specimen found.
Hydnocera, all species occur in meadows and on bushes.
Phyllobanus dislocatus, on dead branches.
Ichneua laticornis, lives parasitic on *Phlæosinus dentatus*.
Chariessa pilosa, on dead branches of deciduous trees.
Cregya, like *Chariessa*.
Orthopleura damicornis, on branches of oak.
Necrobia, all on dried animal matter.

DERODONTIDÆ.

- Derodontus maculatus*, on mold under loose bark of trees.
Laricobius erichsoni, found many years ago on pine in the Smithsonian grounds.

PTINIDÆ.

- Gibbium psylloides*, one specimen found at the wall of the United States Treasury building.
Ptinus fur and *brunneus*, in houses; *quadrimaculatus* and *interruptus*, one specimen of each in white rotten oak.

- Eucrada humeralis*, on bushes.
Ernobius mollis, on old woodwork; the others beaten from pine branches.
Ozognathus floridanus, two specimens, beaten from bushes.
Oligomerus, all on dead branches.
Sitodrepa panicea, everywhere, in houses.
Hadrobregmus, beaten from dead branches.
Trichodesma gibbosa, in old branches.
Anobium notatum, on old oak branches.
Trypopytus sericeus, on old branches.
Petalium bistriatum, very common on dead branches.
Theca, *Eupaetus*, and *Xyletinus*, all on old twigs.
Lasioderma serricorne, in drugs and tobacco.
Hemiptychus, all species on dead branches.
Protheca hispida and *puberula*, in old rotten wood, common.
Dorcatoma, all in dead branches.
Cœnocara oculata, in *Lycoperdon*.
Ptilinus ruficornis, boring in old wood.
Endecatonus rugosus, in old timber.

BOSTRICHIDÆ.

- Most of the *Bostrichidæ*: *Stephanopachys*, *Lichenophanes*, *Xylobiops*, etc., bore in dead twigs or are found under loose bark. *Dinoderus* and *Rhizophortha* are importations.

LYCTIDÆ.

- Lyctus* and *Trogoxylon*, both in old woods.

CUPESIDÆ.

- Cupes concolor*, on old wood.

LYMEXILIDÆ.

- Lymexylon sericeum*, boring in old oak wood.
Micromalthus debilis, one specimen found in the city.

CIOIDÆ.

- Cis*. All species live in fungi growing on logs and stumps; quite a number of species are not determined yet.

ECOLOGICAL NOTES—Continued.

Eumearthron thoracicorne, like *Cis*; several undetermined species.

Ceracis sallei, like *Eumearthron*.

Rhipidandrus paradoxus, in a white fungus at the base of trees.

SPHINDIDÆ.

Sphindus americanus, in fungi growing on timber.

LUCANIDÆ.

Lucanus claphus, one specimen said to be found in Washington; *dama*, not rare at electric lights.

Dorcus parallelus, in white rotten wood.

Platycerus and *Ceruchus*, like *Dorcus*.

Nicagus obscurus, on sand banks along the Eastern Branch.

PASSALIDÆ.

Passalus cornutus, boring galleries in old stumps and logs.

SCARABÆIDÆ.

Canthon laevis and *vigilans*, common in dung; *viridis*, under old leaves.

Charidium histeroides, in decaying fungi.

Copris, all in dung.

Phanus carnifer, in human excrements.

Oonthophagus hecate, *tuberculifrons*, and *pennsylvanicus*, in dung; *janus* and varieties, in decaying toadstools and fungi.

Aphodius. All species of this genus live in various kinds of dung; only *serral* is found under old leaves, and *oblongus* in hollow trees.

Dialytes truncatus and *striatulus*, in horse manure.

Atanius, all species found in rich grounds; *figurator*, found at electric light.

Rhyssenus scaber, under stones in wet sandy places.

Pleuraphorus cersus, in rich soil; *ventralis*, one specimen.

Psammodius interruptus, in sandy places along the river; *axialoides*, one specimen.

Egialia, one undescribed specimen.

Ochodzeus musculus, one specimen.

Bolboceus, found occasionally in roads.

Odontzeus cornigerus, like *Bolboceus*.

Geotrupes, all in rotten fungi and dung; *hornii*, under the stem of a toadstool, also at electric lights.

Cleonus aphodioides, in rotten wood.

Trox, all the species are found in dried carcasses of mammals and birds, also at electric lights.

Hoplia, found flying on sandy soil.

Dichelonycha, on bushes.

Serica vespertina, very common under stones and logs in spring; *iricolor* and *sericea* on bushes; *troxiformis*, rare.

Macroductylus subspinosus, the well-known rose chafer.

Diplostaxis, the species are all found under stones and on bushes.

Lachnosterna. There are 26 species in the District. All are found on trees at night, or attracted by lights.

Anomala marginata, on grapevine; the others all on pine.

Strigoderma, the two species are on blossoms of *rubus*.

Pelidnota punctata, common on grapevine.

Cotalpa lanigera, on cottonwood trees.

Cyclocephala, flying after dusk.

Chalepus trachypygus, on muddy grounds along the river, and abundant at electric lights.

Ligyrus, in moist sandy places.

Aphonus, in old decayed stump of trees.

Xyloryctes satyrus, larva very abundant under stones in pastures.

Strategus anticus, in rotten wood.

Dynastes litigus in rotten wood, not common.

Phileurus rufus, one specimen dug out from the ground.

Allothina nitida, extremely abundant in spring.

Euphoria inda, very abundant in early spring; *areata* in sandy roads; *herbacea* on bushes; *fulgida* and *sepedeuralis* on blossoms.

Cremastochilus leucostictus, one specimen occurred at Odenton, Maryland. All the others are found in nests of various ants, also flying on roads.

Osmoderma cremicola and *scabra*, in rotten trees.

ECOLOGICAL NOTES—Continued.

Cinorinus maculosus, on blossoms, very rare.

Trichius, all species are found on flowers and blossoms.

Valgus, in decaying chestnut trees.

SPONDYLIDÆ.

Parandra brunnea, under bark of old deciduous trees.

CERAMBYCIDÆ.

Orthosoma brunneum, under loose bark.

Prionus, like *Orthosoma*.

Sphenostethus tastei, not common on bushes.

Asemum mastum, on pine.

Crioccephalus, frequently met with in lumber yards.

Suodidum cucujiforme, abundant under bark.

Hylotropes bajulus, on posts, lumber, etc.; *ligneus*, on juniper.

Phyactodes varius, in oaks; *amoenus*, in grapevine.

Callidium, all common on pine.

Eme rigida, on juniper.

Gracilia minuta, on twigs of trees.

Chion cinctus, in hickory and oak.

Eburia quadrigeminata, in lumber yards and attracted by light.

Romuleum atomarium and *rufulum*, both not common.

Elaphidion villosum, extremely abundant; *mucronatum*, common; *unicolor*, less common; *subpubescens* and *cinerascens*, rare.

Tylonotus bimaculatus, rare, a specimen found at electric light.

Heterachthes quadrimaculatus and *ebenus*, both rare.

Carius, *Phyton*, *Obrium*, beaten from branches and twigs.

Callimoxys sanguinicollis, on flowers.

Molorchus bimaculatus, on blossoms.

Rhopalophorus, on flowers.

Tragidion cognus, rare.

Purpuriceus humeralis, on hickory and oak; *axillaris*, rare.

Batyle suturalis, very common on flowers.

Stenosphenus notatus, on various trees.

Cyllene pictus, on hickory in spring; *robiniæ*, very common on solidago in autumn.

Calloides nobilis, rare.

Arhopalus fulminans, rare.

Cytus marginicollis, not common.

Xylotrechus colonus, very common; *sagittatus*, in pine; *quadrimaculatus*, rare.

Neoclytus, on flowers and running on trees.

Clytanthus ruricola and *albofasciatus*, both rare.

Microclytus gazellula, one specimen.

Cyrtophorus verrucosus, common on flowers.

Tillomorpha geminata, bred from sumac.

Euderces picipes, very common on flowers; *pini*, in lumber yards.

Atimia confusa, not common on juniper.

Distenia undata, in grapevine.

Desmocerus palliatus, on sambucus.

Necydalis mellitus, one specimen.

Encyclops curuleus, on flowers.

Rhagium lineatum, very common under pine bark.

Centrodera decolorata and *picta*, of both single specimens.

Toxotus trivittatus, one specimen.

Acanrops directa, not common; *discoidea*, one specimen.

Gaurotes cynipennis, on blossoms.

Strangalia and *Typocerus*, all on blossoms.

Leptura, all on blossoms and flowers; *marginata*, very rare; *hæmatites*, *circumdata*, *pubera*, are rare; *lineola*, *nitens*, *vittata*, *vagans*, *cornifera*, *proxima*, are common; of *subhamata* and *mutabilis*, single specimens.

Euryptera lateralis, rare.

Cyrtinus pygæus, common on trees and bushes.

Psenocerus supernotatus, common on various deciduous trees.

Monohammus, on pine; also in our lumber yards.

Dorcaschena wildii, on osage orange; *alternatum*, on mulberry and osage orange; *nigrum*, rare.

Helamis cinerea, on mulberry and hickory.

Cucoplia pullata, one specimen.

Goes tigrina, *pulverulenta*, *oculata*, and *tessellata*, on bushes; *pulchra*, on hickory; *debilis*, on white oak.

Plectrodera sculator, on willow; two specimens near the Free Bridge.

ECOLOGICAL NOTES—Continued.

- Acanthoderes quadrigibbus*, rather rare; *decipiens*, very common; *morrisii*, very rare.
- Leptostylus* and *Liopus*, all on old twigs and dead branches.
- Dectes spinosus*, common on various weeds.
- Lepturges*, like *Leptostylus*.
- Hyperplatys*, like the preceding.
- Trographis fasciata*, on deciduous trees.
- Ceratographis pusillus*, in pine trees.
- Acanthocinus obsoletus* and *nodosus*, in pine.
- Pogonocherus micetus*, in pine, rare.
- Ecyrus dasycerus*, very common on deciduous trees.
- Eupogonius tomentosus*, not rare on pine; *vestitus*, on bushes; *subarmatus*, rare on beech.
- Oncideres cingulata*, on persimmon.
- Ataxia crypta*, on old branches.
- Hippopsis lemniscata*, on weeds.
- Saperda obliqua*, on alnus; *caudata*, on apple trees; *tridentata* and *vestita*, on elm; *lateralis*, on willows; *puncticollis*, on *Rhus toxicodendron*.
- Ochrea bimaculata*, on rubus; *3-punctata*, on solidago; *ocellata*, and *gracilis*, rare; *ruficollis*, on sumac and sassafras.
- Tetrops monostigma* and *juvanda*, on meadows.
- Tetraopes tetraophthalmus*, on *Asclepias cornuti*; *cauteriator*, on an orange-colored asclepias; *5-maculatus*, on specimen.
- Amphionycha flammata*, on bushes.
- Dysphaga tenuipes*, in hickory; *teris*, one specimen.

CHRYSOMELIDÆ.

- Donacia cincticornis*, *paludata*, and *piscatrix*, on aquatic plants; the others on swampy meadows; the only specimens of *hypoleuca* were found at electric light.
- Harmonia nigricornis*, in swamps on water plants.
- Orosodaena atra*, on willow blossoms in early spring.
- Zengophora puberula*, on poplar.
- Symeta ferruginea*, rare.
- Lema sayi*, on *Commelyna virginica*, along the Potomac Flats; *trilineata*, on potatoes; *6-punctata* and *brunnicollis*, in meadows.
- Crioceris asparagi* and *12-punctata*, on asparagus, imported.
- Anomea laticlavia*, common on robinia.
- Coscinoptera dominicana*, on bushes and herbs.
- Babia* and *Saxinis*, on meadows.
- Chlamys*, larva on sycamore.
- Erema gibber* and *conspersa*, in meadows and on shrubs.
- Bassareus* and *Cryptocephalus*. All species of these genera live on various flowers and bushes; only *schreibersii* on pine.
- Gribarius equestris*, on wild roses.
- Pachybrachys*, like *Cryptocephalus*; *tridens*, on *Rhus toxicodendrons*; there are some unrecognized forms.
- Monachus*, *Diachus*, *Triachus*, all on bushes and plants in meadows; *Diachus leris* and *Triachus rucus* are rare.
- Fidia viticida* and *longipes*, common on grapevine.
- Xanthonia*, very common on various bushes.
- Myochrous denticollis*, by sweeping meadows.
- Glyptoceclis pubescens* and *barbata*, common on pine.
- Graphops*, in meadows, especially on clover.
- Typophorus canellus* and varieties, very common in meadows; *viridicyaneus*, rare.
- Metachroma*, on bushes, especially oak.
- Chrysochus auratus*, common on apocynum.
- Tymnus tricolor*, common on bushes.
- Colaspis*, common on meadows and bushes.
- Rhabdopterus picipes*, like *Colaspis*.
- Nodonota*, on flowers and bushes.
- Chrysodina*, like *Colaspis*, very common.
- Prasocuris varipes*, on swampy grounds.
- Labidomera clivicollis*, on *Asclepias incarnata*.
- Leptinotarsa decemlineata*, the well-known potato beetle; *juncta*, has disappeared from our fauna since the arrival of *decemlineata*.
- Zygogramma* and *Calligrapha*, all on meadows and weeds.
- Plagioderia viridis*, very common on cruciferous plants.

ECOLOGICAL NOTES—Continued.

- Gastranclea cyanea*, on rumex.
Lina lapponica and *scripta*, on willows.
Monocista coryli, on elm, rare.
Trirhabda tomentosa, rare; *virgata*, one specimen.
Galerucella americana, on solidago; *rufosanguinea*, on *Azalea nudiflora*; *nymphææ*, on nymphæa and other aquatic plants; *decora*, on willows; *notata*, on eupatorium; *xanthomelæna*, on elm.
Diabrotica, *12-punctata* and *vittata*, common everywhere; *atripennis*, rare.
Phyllobrotica discoides and *limbata*, on swampy grounds.
Luperodes meraca and *cyaneus*, on meadows.
Phyllethrus dorsalis and *gentilis*, on lepedeza.
Ceratomya trifurcata, common on bushes and meadows.
Blepharida rhois, on rhus.
Pachyonychus paradoxus, on smilax.
Hypolampsis pilosa, not rare.
Edionychis, more or less common by beating meadows; *rians*, very common; *indigoptera*, one specimen.
Disonycha, like *Edionychis*; *5-vittata*, one specimen.
Spharoderum opima, several specimens by sweeping.
Haltica chalybea, on grapevine; *fuscoænea*, on ænothera; *ignita*, everywhere in bushes; *amara*, rare; *marevagans*, one specimen.
Lactica iris and *tibialis*, both rare.
Diphaulaca bicolorata, rare.
Orthaltica copalina, very common on sumac.
Crepidodera rufipes, on black locust; *helvææ*, very abundant on willows; *atripennis*, abundant on meadows.
Epitricæ, very abundant on various low plants; *pareula*, on solanum.
Mantura floridana, swampy meadows.
Chatocæna, all on meadows; *subcylindrica* and *protensa* are rare.
Systema, all on bushes and lower plants.
Glyptina, by sweeping meadows.
Aphthana insolita, very rare.
Phyllotreta, all on cruciferous plants, except *pieta*.
Longitarsus, all by sweeping meadows.
Dibolia borealis, on plantago.
Psylliodes convexior, on low plants.
Microthopala vittata and *serene*, live on solidago; the others are rare; *welshemeri*, very rare.
Odontota scapularis and *bicolor* on meadows; *dorsalis*, on black locust; *nerosa*, everywhere on bushes; *horni*, very rare.
Charistena ariadne, one specimen.
Ocotoma plicatula, on *Tecoma radicans*.
Stenispis metallica, on swampy meadows.
Cassida nigripes on convolvulus, *bivittata*, on potatoes.
Coptocycla clavata, on oak; the others mostly on convolvulus.
Chelymorpha argus, common on convolvulaceæ.

BRUCHIDÆ.

- Spermoplagus robinie*, on *Gleditsia triacanthos*.
Bruchus pisorum, in peas, imported; *chinensis* and *4-maculatus*, both imported; *biculneratus*, in seeds of *Cassia marylandica*; *distingendus*, on *Ludwigia alternifolia*; *obsoletus*, in seeds of *Tephrosia virginiana*; *obtectus* in beans; *hibisci*, in seeds of *Hibiscus moscheutos*; *exiguus*, in seeds of *Amorpha fruticosa*; *calvus* and *perforatus*, single specimens.
Zabrotes obliteratus and *subnitens*, rare, habits unknown.

TENEBRIONIDÆ.

- Epitragus arundinis*, on bushes.
Phelopsis obcordata, under old bark, one specimen.
Blaps similis, said to be found in Alexandria, Virginia.
Polypleurus geminatus, under stones and chips.
Nyctobates pennsylvanica, abundant under loose bark.
Merinus laevis, like *Nyctobates*.
Hapladrus femoratus and *ater*, under loose bark.
Scotobates calcaratus, common under bark.
Xylopinus, under bark; *anesens*, rather rare.
Tenebrio obscurus and *molitor*, introduced species; *castaneus* and *tenebrioides*, under loose bark.

ECOLOGICAL NOTES—Continued.

Opatrinus notus, very common under stones.

Blapstinus, under stones and chips in sandy places.

Tribolium ferrugineum and *confusum*, under bark, introduced.

Lyphid ficicola, rare.

Diadus punctatus, very common under bark.

Echocerus macillosus and *dentiger*, both imported.

Alphitobius diaperinus, common, imported.

Uloma, all in rotten wood.

Aeothia picea, under stones and in moss. *Auedus brunneus*, exceedingly common under old leaves.

Paratenetus, very common on dry leaves.

Prateus fuscus, in rotten wood, rare.

Diaperis hydri, in fungi, abundant.

Arrhenoplitia bicornis and *viridipennis*, on various fungi.

Platydema. The species of this genus live all under bark infested with fungi; *ruficollis*, rare.

Phylethrus bifasciatus, in fungus.

Putorius ratzeburgi and *subdepressus*, in seeds, imported.

Hypophlaeus, parasitic on Scolytids; *piliger*, rare.

Pentaphyllus pallidus, in fungus.

Boletotherus bifurcus, in hard fungi growing on trees.

Boletothagus corticola, under old bark.

Helops micans, *americanus*, and *areus*, at the base of trees; *reustus*, on dead branches of oak.

Meracantha contracta, on old trees.

Strongylium tenuicollis and *terminatum*, in rotten wood.

CISTELIDÆ.

Allecula atra and *punctulata*, on dry twigs.

Hagenorus, on bushes and dead branches.

Cistela brevis and *marginata*, on flowering trees.

Isomira, on flowers and bushes.

Myctochares, on old wood, but rare.

Chromatia amara, rare.

Capnochroa and *Androchirus*, on bushes and old twigs.

LAGRIIDÆ.

Arthromacra zeuxa, common on bushes.

Stalira, like *Arthromacra*.

MONOMMIDÆ.

Hyporhagus punctulatus, common on chestnut logs.

MELANDRYIDÆ.

Tetraloma tessellata, on rotten twigs; *truncorum*, rare.

Pisenus humeralis, in fungi, not common.

Penthe, in fungi growing on logs and stumps.

Synchroa punctata, very common under bark.

Eustrophus and *Holostrophus*, in fungi.

Orchesia, in hard fungi growing on trees. *Hallomenus*, on fungi.

Microscapha claricornis, common on dead twigs.

Melandrya, under old bark.

Curebara longula, on pine twigs; one specimen.

Spilotes 4-pustulosus, common on twigs.

Enchodes sericea, from a felled old tree; one specimen.

Mystaxia simulator, under bark.

Hypubus lituratus, common on moss growing on trees; *concolor*, rare; *vaudoueri*, one specimen.

Symphora flavicollis and *rugosa*, both common everywhere.

Anisoxya glaucula, on dead twigs.

Scaptia sericea, very common on blossoms.

Allopotis lutea, on flowers.

Canifa, very common on bushes.

Nothus varians, on *Cyatagus*.

Mycteris scaber, on flowers.

PYTHIDÆ.

Boros unicolor, under pine bark, once found across the Free Bridge.

Pytho americanus, under bark of stumps, rare.

Salpingus virescens, rare, two specimens.

Rhinosisinus viridiæneus, one specimen.

CEDEMERIDÆ.

Microtonus sericans, very common on bushes.

ECOLOGICAL NOTES—Continued.

Naccodes melanura, everywhere in the city.

Orucis, *Probosea*, and *Asclera*, all on flowers.

MORDELLIDÆ.

Pentaria trifasciata, on flowers, common.

Anaspis flavipennis and *rufa*, on flowers.

Tomoxia lineella on old twigs; *inclusa*, one specimen.

Mordella, all the species live on bushes and flowers.

Mordellistena. The very numerous species of this genus live partly on flowers, partly on dead twigs.

ANTHICIDÆ.

Stereopalpus mellyi, on bushes near water.

Coryphra, on flowers in swampy localities.

Xylophilus melsheimeri, *basalis*, *nebulosus*, and *fasciatus*, on bushes; *subfasciatus*, under old leaves and bushes; *brunni-pennis*, under bark of sycamore; *notatus*, rare; *impressus*, on pine.

Macratria confusa and *murina*, on bushes near water, very common.

Notoxis anchora, *monodon*, on flowers and bushes, very common; *bicolor*, under old leaves, very abundant.

Mecynotarsus candidus, on sand banks near Eastern Branch.

Anthicus. The numerous species live either on flowers or on the banks of the river.

PYROCHROIDÆ.

Ischalia costata, in white rotten wood, rare.

Pyrochroa flabellata and *femoralis*, under chips of wood.

Dendroides canadensis, under bark of trees.

MELOIDÆ.

Meloe, all species are crawling around in early spring.

Tricrania sanguinipennis, found in Rock Creek Valley on gravelly grounds.

Nemognatha nemorensis and *cribraria*, on flowers of solidago.

Zonitis bilineata, on flowers.

Hornia minutipennis, in clay banks inhabited by *Anthophora abrupta*.

Macrobasis unicolor, on solidago and potatoes.

Epicauta pennsylvanica and *cinerea*, on solidago and solanum; *rittata* and *lenniscata*, on potatoes; *strigosa*, on flowers; *trichrus*, on convolvulus.

Pyrota germari and *limbata*, on solidago.

Pomphopœa wæna, on willows.

RHIPIPHORIDÆ.

Pelecotoma flavipes, rare.

Rhipiphorus, all on flowers.

Mygodites fasciatus and varieties, on solidago and sumac.

STYLOPIDÆ.

Xenos peckii, parasitic on polistes.

RHINOMACERIDÆ.

Rhinomacer pilosus and *elongatus*, very common on dying pine trees.

RHIYNCHITIDÆ.

Auletes cassandrae, on bushes.

Eugnamptus angustatus and *collaris*, on sycamore and other trees.

Rhynchites, on various bushes, mostly oak.

Pterocolus oratus, on oak bushes.

ATTELABIDÆ.

Atelabus, mostly on oak bushes.

OTIORHYNCHIDÆ.

Epicærus imbricatus, common on dry meadows.

Hormorus undulatus, rare.

Panoscopus erinaceus, wild grapevines, June, July.

Phyvelis rigidus, under stones.

Otiorynchus sulcatus, one specimen in Oak Hill Cemetery; *oratus*, two specimens.

Cercopus chrysothorax, in early spring, under chips and stones.

Tanymecus confectus, on dry meadows; common.

Pandeletejus hilaris, extremely abundant on branches and bushes.

Brachystylus acutus, exclusively on persimmon.

ECOLOGICAL NOTES—Continued.

Aphrastus tenuatus, on hazel and other bushes.

CURCULIONIDÆ.

Sitones flurescens and *hispidulus*, very common on clover.

Ithycerus uoreboracensis, on hickory.

Apion. All species occur on dry or moist meadows, on shrubs and bushes; only a few of them have been bred, and the food plants of these have been repeatedly recorded.

Podapion gallicola, bred from its gall on *Pinus rigida*.

Phytonomus comptus, on meadows; *punctatus*, is the well-known imported clover-leaf beetle.

Listronotus, all the species are found on sandy and muddy grounds near water.

Macrops, like *Listronotus*.

Pissodes strobi, common on pine.

Pachylobius and *Hyllobius*, like *Pissodes*.

Eudocimus mannerheimi, rare.

Lixus, all occur on rather low meadows.

Dorytomus brevicollis, on poplar.

Pachyphanes amicus, on Cuscuta.

Smicronyx. All the species are found by sweeping on meadows.

Promecotarsus gibbistris, like *Smicronyx*.

Phyllotrox ferrugineus, on bushes.

Brachybanus, *Onychylis*, *Endalus*, *Tanypterus*, *Lissorhopus*, and *Bagous*, all these genera are found on palustral plants.

Otidoccephalus. Our species are inquiline in Cynipid galls.

Magdalis olya, on hickory; *perforata* and *hispidoides*, on pine; *pandura* and *pallida*, on elm.

Tachypterus quadrigibbus, on Crataegus and apple.

Anthrenomus gularis, in pods of cassia; *suturalis* in wild plum; *sycophanta*, inquiline in willow galls; *juniperinus*, in the juniper fungus; *moleculus*, on solidago; *ungularis*, in *Cassia marylandica*; *signatus* in *Fragaria* and rosaceous plants.

Pseudanthonomus cratagi, on crataegus.

Xanthus pygmaeus, on juniper.

Elleschus ephippiatus, on willow.

Acalyptus carpini, on willow blossoms.

Orchestes salicis niger, *pallidicornis*, on willows; *betuleti*, on *Betula nigra*.

Prionomerus calcatus, on sassafras.

Piazorhinus scutellaris, very common on bushes; *pictus*, rare.

Thysanocnemis helrolus and *fracini*, in seeds of *Fraxinus*.

Plocetes ulmi, on *Cephalanthus occidentalis*.

Gymnetron teter, on verbascum.

Miarus hispidulus, on *Lobelia siphilitica*.

Lamnosuccus plagivus, on oak bushes.

Conotrachelus juglandis and *elegans*, on hickory; *cratagi*, on crataegus; *neuraphar*, on plum; *tuberosus*, on urtica; *fissunguis*, on hibiscus; *unaglypticus*, under moist bark and various bushes, very common; *hispidus*, rare.

Rhyscenatus lineaticollis, in the pods of asclepias.

Chalcodermus collaris, rare.

Microhys setiger, on dead branches.

Acanthus rigidus, in red-rotten wood.

Acalles, all under decaying leaves.

Tyloclerma foreolatum, in stems of *Enothera biennis*; *fragariae*, on fragaria; *arenum*, on plants growing in bogs.

Phyrdenus undatus, on *Solanum nigrum*.

Cryptorhynchus. All species are on dead twigs.

Piazorus ocellatus, on bushes, very common.

Copturus binotatus, on *Gleditsia triacanthos*; *quercus*, on oak; *longibus*, in podapion galls; *minutus*, on oak.

Acoptus suturalis, common on dead branches.

Tachygonus lecontei, on oak; *tardipes*, rare.

Mononychus vulpeculus, on iris.

Craponius inaequalis, on grapes.

Acanthoscelis curtus and *acephalus*, common on polygonum.

Auletes, all on swampy meadows; *nebulosus* and *asper*, rare.

Pelecosomus cristatus, one specimen.

Acallodes ventricosus, rare.

Centorhynchus rapax, on lepidium and other cruciferous plants; the other species all live on plants in marshy ground.

Cologaster zimmermanni, on swampy places.

Perigaster cretura, like *Cologaster*.

ECOLOGICAL NOTES—Continued.

Pelenomus sulcicollis, on polygonum.
Rhinoncus pericarpus, *pyrrhopus*, and *longulus*, all on polygonaceous plants.
Baris, the species are obtained by sweeping meadows.
Plesiobaris T-signum and *disjuncta*, in swampy meadows.
Glyptobaris, *Oxychobaris*, and *Aulobaris*, all are obtained by sweeping marshy meadows.
Ampelogypter ater and *Madarrellus*, on ampelopsis.
Desmoglyptus crenatus, on wild grape.
Pseudobaris pectoralis and *nigrum* on meadows.
Trichobaris trimotata, on potatoes.
Centrinus. All live on flowers, especially in the fall.
Centrinopus, *Nicentrus*, *Limnobaris*, *Oligolochus*, *Idiostethus*, and *Stethobaris*, all these genera live on various herbs and weeds in meadows.
Zuglyptus striatus and *sulcatus*, in dead twigs.
Oomorphidius lericollis, one specimen.
Barinus cribricollis and *curticollis*, rare.
Barilepton filiforme, in swampy meadows.
Plocamus hispidulus, breeds in dead twigs of *Robinia pseudacacia*.
Balaninus. The habits of these species have repeatedly been placed on record.

BRENTHIDÆ.

Eupsalis minuta, under loose bark of various trees.

CALANDRIDÆ.

Rhodobæus 13-punctatus, very common on meadows.
Sphenophorus. The species live on the roots of grasses in sandy places; *ochreus*, *melanocephalus*, *sculptilis*, and *parvulus* are very abundant.
Calandra oryza and *granaria*, in stored rice, wheat, corn, etc.
Dryophthorus corticalis, very common under bark of rotten trees.
Himantium errans, under bark; *conicum*, in bark of *Liriodendron tulipifera*.
Cossonus impressifrons, under bark of various trees.

Stenomimus pallidus, under bark, rare.
Phloeophagus apionides and *minor*, on dead twigs.
Wollastonia quercicola, like *Phloeophagus*.
Amaworhinus nitens, on dead branches of grapevine.
Herarthrum ulkei, rare, seems to be imported.
Rhyocolus oregonensis, rare.
Stenoscelis brevis, common in rotten wood.
 There are several underscribed *Calandrida*.

SCOLYTIDÆ.

Scolytus quadrispinosus, on hickory; *muticus*, on celtis; *rugulosus*, on fruit trees.
Chramcesus icorice, in branches of hickory.
Phloeotribus liminaris, on fruit trees; *frontalis*, on *Morus rubra*.
Hylesinus aculeatus, under bark of ash; *opaculus*, under elm bark; *fasciatus*, rare, infests twigs of *Fraxinus*.
Cnesinus strigicollis, on liquidambar.
Phloeosinus dentatus, under bark of juniper.
Cyphoborus bifurcus, under pine bark.
Dendroctonus terebrans, under pine bark; *frontalis*, one specimen.
Hylastes, all on pine; also *Hylurgops pinifer*.
Crypturgus abutaceus, on pine.
Cryphalus rigidus, on beech, one specimen.
Coccotrypes ductyliperda, found occasionally in dates in our fruit stores.
Hypothenemus eruditus and *dissimilis*, found abundantly in dry twigs of various trees in early spring.
Pityophthorus minutissimus, under oak bark; *pulicarius*, *pallus*, *puberulus*, *annectens* and *hirticeps*, on pine; *consimilis*, on rhus.
Pityogenes plagiatas, on pines.
Xylocleptes decipiens, rare.
Tomicus. All under bark of pines.
Dryocetes granicollis, rare.
Micracis saturalis and *opacicollis* boring in old twigs; *rudis*, in willow, rare.
Thysanoes fimbriicornis, in dead hickory twigs.
Gnathotrichus materiarius and *asperulus*, in pine.

ECOLOGICAL NOTES—Continued.

Xyleborus tachygraphus, bores in *Acer dasycarpum* and other trees, on the shore of the river; *dispar*, in apple; *celsus*, in hickory; *biographus*, male of *celsus*; *fuscatus*, very common in oak; *planicollis*, probably male of *fuscatus*; *retusicollis*, probably male of *pubescens*; *xylographus*, abundant on oak.

Xyloterus scabricollis, rare; *politus*, common, bores in *Acer dasycarpum*.

Corthylus punctatissimus, common in the roots of *Vaccinium corymbosum*.

Monarthrum fasciatum and *mali*, very abundant in deciduous trees.

Platypus flavicornis and *quadridentatus*, mostly boring in pine.

ANTHRIBIDÆ.

Eurymycter fasciatus, on old branches.

Tropideres bimaculatus and *rectus*, on dead twigs.

Hormiscus, *Toxotropis* and *Eusphyrus*, all common on old twigs.

Piezocorynus dispar, *maratus* and *mixtus*, on old logs and under loose bark; *mixtus* rather rare.

Anthribus cornutus, not rare on dead branches.

Cratoparis lunatus and *lugubris*, in fungi growing on old logs; *lunatus*, exceedingly common; *lugubris*, rare.

Brachytarsus alternatus and *variegatus* very common on meadows; *tomentosus*, very common on ambrosia.

Anthribulus rotundatus, on swampy meadows, common.

Choragus, not rare on dead twigs.

Euxenus punctatus, on twigs, rare.

SOME NEW SOUTH AMERICAN BIRDS.

By HARRY C. OBERHOLSER.

Assistant Ornithologist, Department of Agriculture.

During the course of various recent systematic researches in the bird collection of the United States National Museum, the following South American species and subspecies, apparently new, were incidentally brought to light. They for the most part belong to the Tyrannidae and other mesomyodian families. In several instances the specimens had been for a long time in the United States National Museum collection, but either undetermined or misidentified.

For privileges of investigation and publication, as well as for many accessory courtesies, the thanks of the author are due Mr. Ridgway, the curator of the division. In three cases where material from other museums forms the basis of description, indebtedness to the proper source is acknowledged.

Family FORMICARIIDÆ.

THAMNOPHILUS TEPHROGASTER, new species.

Chars. sp.—Similar to *Thamnophilus caeruleescens* in form and general color, but differs in having the abdomen and crissum pale slate gray instead of white, the lower tail-coverts barred with blackish.

Description.—Type, adult male, No. 32846, U.S.N.M.; Bahia, Brazil. Pileum, nape, and middle of back black, the latter with large concealed spots of pure white; remainder of upper surface, the superciliary stripe, sides of head and neck slate color, the lores and auriculars mixed with blackish; tail black, broadly tipped with white, and with a bar, or lengthened spot, on the middle of the exterior web of each of the outer rectrices; wings fuscous, the secondaries margined externally with slate color, the primaries narrowly with white, the superior wing-coverts all black with broad white tips; lower surface slate gray, paler posteriorly, where obsolete barred with grayish; crissum light slate gray, barred rather indistinctly with slaty blackish; lining of wing grayish white. Length of wing, 71 mm.; tail, 66 mm.; exposed culmen, 13.5 mm.; tarsus, 23 mm.; middle toe, 14 mm.

This new *Thamnophilus* has apparently hitherto been confounded

with *Thamnophilus caeruleescens*, from which, however, it is at least subspecifically distinct. All the specimens we have seen are from Brazil, and are quite uniform in characters, though some of them are more plainly barred on the lower tail-coverts than is the type; and while the present form may ultimately prove to be but the geographical representative of *T. caeruleescens* in Brazil, there is at present no evidence of intergradation. From *Thamnophilus naevius*, with which it agrees in general appearance, it differs in decidedly shorter, weaker bill, somewhat paler abdomen, and broader bar on the median portion of the outermost rectrix. A female, apparently belonging to this new species, has a shorter bill than the same sex of *T. naevius*, is appreciably less rufescent above, with the tail, particularly on the middle feathers, more blackish; and in place of the dull, grayish ochraceous of *naevius*, is conspicuously rufous below, anteriorly shaded with olive.

This form seems never to have received a name, since *Thamnophilus caeruleescens* Vieillot,¹ and *Thamnophilus auratus* of the same author,² both based on Paraguay specimens, as well as *Thamnophilus ventralis* Selater,³ all refer undoubtedly to the white-vented bird. It is barely possible that *Thamnophilus pileatus* Swainson⁴ is the immature male of the bird here described, but unless considerable allowance is to be made for error of description this seems not to be the case.

Family FURNARIIDÆ.

SYNALLAXIS SPIXI NOTIUS, new subspecies.

Chars. subsp.—Similar to *Synallaxis spixi spixi*, but much more grayish above; sides, flanks, and crissum grayish, or but very slightly rufescent.

Description.—Type, adult male, No. 55783, U.S.N.M.; Conchitas, Buenos Ayres, Argentine Republic, November, 1868; William H. Hudson. Crown and forehead bright chestnut; rest of upper parts dark grayish brown, somewhat rufescent on the back; tail similar, but slightly darker; wings fuscous, margined externally with olive, the median and lesser coverts chestnut, the greater series edged with the same; sides of head and neck, including supraorbital region, deep brownish gray; center of chin and throat black with silvery gray tips to many of the feathers; remainder of lower surface down to the breast brownish gray; abdomen pale brownish gray, the sides and crissum much darker and with a very slight tinge of rufous; lining of wing buff. Length of wing, 49 mm.; tail, 71 mm.;⁵ exposed culmen, 14 mm.; tarsus, 19 mm.; middle toe, 13 mm.

¹ Nouv. Dict. d'Hist. Nat., III, 1816, p. 311.

² Iden, p. 312.

³ Edinburgh New Philos. Journ., new ser., I, 1855, p. 244.

⁴ Zool. Journ., II, 1825, p. 91.

⁵ Tail imperfect.

The type of *Synallaxis spixi* came from Brazil, and it is on the strength of comparison with birds from that country that the present separation is made. A specimen from Paraguay seems to be somewhat intermediate, though agreeing substantially with Brazilian birds.

XENICOPSIS PERCNOPTERUS, new species.

Chars. sp.—Allied to *Xenicopsis oleagineus*, but more rufescent throughout; upper surface somewhat darker, superciliary more deeply ochraceous; breast more strongly tinged with ochraceous; lining of wing darker.

Description.—Type, adult male, No. 177706, U.S.N.M.; Alto da Serra, Brazil, August 8, 1899; J. Lima. Upper parts uniform reddish olive brown, a little paler on the rump and upper tail-coverts, the feathers with slightly darker margins, producing an obsolete squamate effect; wings like the back but more rufescent; tail plain chestnut; superciliary stripe deep ochraceous; lores ochraceous, mixed with olive brown; cheeks, sides of head and neck olive brown, inclining to blackish, with broad shaft streaks of buffy and white; chin and upper throat pale buff, the feathers all tipped with olive; remainder of lower surface olive brown, rather lighter than that of the upper parts, streaked broadly and sharply with buffy white and ochraceous, these markings narrow on flanks, sides, and crissum; lining of wing deep fulvous; inner margins of remiges dull ochraceous. Length of wing, 79 mm.; tail, 73 mm.;¹ exposed culmen, 18 mm.; tarsus, 22 mm.; middle toe, 18.5 mm.

In the character of the streaking below this new species agrees with both *Xenicopsis oleagineus* and *Xenicopsis acritus*,² differing further from the latter in its decidedly more rufescent color both above and below, and in the strongly buffy instead of yellowish shade of the light areas on the breast and lower throat. There is no difficulty in distinguishing the present species from *Xenicopsis rufosuperciliatus*, since the much more distinctly streaked, less rufescent lower surface, the paler superciliary stripe, with the much darker, more olive upper parts, serve to separate it almost at a glance. There seems to be little if any difference in size between any of the five closely allied species, *Xenicopsis rufosuperciliatus*, *X. oleagineus*, *X. cabanisi*, *X. acritus*, and *X. percnopterus*.

Family TYRANNIDÆ.

OCHTHOECA RUFIMARGINATA ACROPHILA, new subspecies.

Chars. subsp.—Similar to *Ochthoeca rufimarginata rufimarginata*, but entire upper surface rufescent instead of sooty brown.

Description.—Type, adult male, No. 32915, U.S.N.M.; Rio Napo.

¹Tail not fully grown.

²Oberholser, Proc. Biol. Soc. Washington, XIV, 1901, p. 187.

Ecuador. Pileum bister brown; rest of upper parts mummy brown; tail plain fuscous, edged externally with the color of the back; wings fuscous, the lesser and median coverts mummy brown, the latter broadly tipped with dull rufous; the greater series bister, tipped as the median series; outer webs of the secondaries with narrow dull rufous margins, those of the innermost more extensive and somewhat paler; superciliary stripe brownish white; lores and auriculars like the pileum; cheeks brownish white; chin and upper throat dull white; sides of breast mummy brown, the breast pale brownish; remainder of lower surface pale dusky brownish yellow, the sides rather duller; lining of wing light yellowish. Length of wing, 64 mm.; tail, 66 mm.; exposed culmen, 10 mm.; tarsus, 20.5 mm.; middle toe, 10.5 mm.

The differences characterizing this new form are not such as may be graphically described, but they are nevertheless quite apparent on comparison of specimens. The rufescent hue pervading the upper parts is prevalent also on the sides of the breast and adjacent portion of the neck, invading as well to an appreciable extent the brownish suffusion of the breast. The two races appear to be alike in size.

The type of *Ochthoeca rufimarginata*, which has been examined in the American Museum of Natural History, came from Quito Valley, and represents apparently the bird found on the central and western Andes, while this new form, evidently but a subspecies, is its representative on the eastern slope of these mountains.

MECOCERCULUS ALUTUS, new species.

Chars. sp.—Similar to *Mecocerculus stictopterus*, but considerably paler, more brownish above, as well as on sides of head and neck.

Description.—Type, No. 42422, American Museum of Natural History, collection of George N. Lawrence; Ecuador. Pileum dull brownish gray; remaining upper parts a medium shade of olive brown, the upper tail-coverts noticeably paler and more brownish; wings and tail fuscous, margined with the color of the back, the greater and median wing-coverts broadly tipped with yellowish white, producing two wing-bars; a broad superciliary stripe white; lores and a small postocular streak dark brown; cheeks and sides of neck dull brownish white; under surface white, anteriorly washed with brownish, the sides, flanks, and crissum tinged with yellowish; lining of wing yellowish white. Length of wing, 59 mm.; tail, 52 mm.; exposed culmen, 7 mm.; tarsus, 17.5 mm.; middle toe, 9 mm.

The single specimen of this bird differs so greatly from examples of *Mecocerculus stictopterus* that its distinctness seems to be certain. It may, however, ultimately prove to be but a subspecies, although evidently a very well-marked one.

The type is the only specimen examined, and for permission to describe it the writer is indebted to the authorities of the American Museum of Natural History, through Dr. J. A. Allen.

MECOCERCULUS STICTOPTERUS EUPLASTUS, new subspecies.

Chars. subsp..—Similar to *Mecocerculus stictopterus stictopterus*, but plumbeous of pileum less tinged with brownish; upper surface of body olive green instead of olive brown; sides of head somewhat paler.

Description..—Type, adult male, No. 159818, U.S.N.M.: Maraynioc, Peru, September 1, 1892; J. Kalinowski. Crown plumbeous; remainder of upper parts olive green; tail fuscous, margined with the color of the back; wings sepia brown, the lesser coverts and innermost secondaries edged with dull olive green, the greater and median wing-coverts and innermost secondaries broadly tipped with buffy white, the remaining wing-quills with external margins of pale olive brown; sides of head dull slate gray, the cheeks mixed with whitish; superciliary stripe white; sides of neck anteriorly grayish above, whitish below, posteriorly dull olive green; lower parts white, the throat and breast shaded with grayish, the sides, flanks, and crissum washed with yellowish; lining of wing pale sulphur yellow. Length of wing, 65 mm.; tail, 59 mm.; exposed culmen, 8 mm.; tarsus, 18 mm.; middle toe, 10 mm.

While possibly a distinct species, this new form so resembles true *Mecocerculus stictopterus* from Ecuador as to appear the subspecific representative of that species in Peru. It is, however, determinable at sight by the very different color of the back. The size of both forms appears to be nearly or quite the same.

RHYNCHOCYCLUS SCOTIUS, new species.

Chars. sp..—Similar to *Rhynchocyclus sulphureus*, but bill broader; upper parts rather duller olive green; edgings of wings and tail less yellowish, this most apparent on the wing-coverts; entire lower surface darker, more dingy, even the median portion of abdomen considerably shaded with olivaceous; lining of wing of a deeper, more olive yellow.

Description..—Type (sex unknown), No. 59181, U.S.N.M.: Brazil (exact locality unknown). Above olive green, the head and nape noticeably shaded with slate color; wings and tail fuscous, margined exteriorly with olive green, this on the remiges and greater wing-coverts more yellowish; lores dusky; supraloral stripe dull white; chin and cheeks dull grayish, mixed with olive green and slaty; auriculars anteriorly olive green, posteriorly blackish; sides of neck olive green; rest of under surface dull grayish olive yellow, brighter on the central abdomen, the crissum tinged with ochraceous; lining of wing olivaceous yellow, the axillars clear sulphur yellow. Length of wing, 66.5 mm.; tail, 60 mm.; exposed culmen, 11 mm.; tarsus, 18 mm.; middle toe, 10 mm.

The single specimen on which is based the above description is unfortunately without further locality than "Brazil," but it is certainly

different from *Rhynchoocyclus sulphureus*, with which it alone needs comparison. From all of a good series of *sulphureus* it differs as we have noted.

PERISSOTRICCUS, new genus.

Chars. gen.—Similar to *Orchilus* Cabanis, but tail very much shorter—less than half of wing, and not decidedly longer than tarsus. Type, *Todirostrum caudatum* d'Orbigny and Lafresnaye.

The species commonly known as *Orchilus caudatus* differs so much from the type of the genus in which it has been placed that its formal separation seems advisable. In addition to the structural characters above given may be added the very different pattern of coloration—unstreaked below, lacking the blackish auricular spot, and with a cinereous or blackish crown. The species are:

Perissotriccus caudatus (d'Orbigny and Lafresnaye).

Perissotriccus atricapillus (Lawrence).

HEMITRICCUS PAMMICTUS, new species.

Chars. sp.—Similar to *Hemitriccus diops*, but upper parts more greenish olive; throat, cheeks, sides, flanks, and crissum much tinged with yellowish olive; edgings of wing-quills more yellowish; wings with two pale yellow bars; bill more compressed.

Description.—Type, adult (sex unknown), No. 23967, U.S.N.M., South America [probably some part of southeastern Brazil], cruise of the *Delaware*; Dr. G. R. Horner. Upper surface olive green, rather paler on the rump; tail fuscous, margined with the color of the back; wings fuscous, edged externally with olive green—this on the quills more yellowish—the innermost secondaries tipped with yellowish white; the greater and median coverts broadly tipped with light yellow, forming two wing-bars; lores, eye ring, and ill-defined superciliary stripe dull yellowish white; cheeks pale olive yellow; sides of neck dull light olive green; chin and throat pale dingy olive yellow; remainder of lower surface dull white, the breast tinged with brownish buff, the sides, flanks, and crissum shaded with olive yellow; lining of wing sulphur yellow. Length of wing, 50 mm.; tail, 48 mm.; exposed culmen, 9 mm.; tarsus, 17.5 mm.; middle toe, 9 mm.

The single specimen of this new species has been for a long time in the National Museum, and has been labeled *Phylloscartes ventralis*, but apparently is not even generically identical, as a comparison of specimens readily proves. In fact, it is much nearer *Hemitriccus diops* than to any other species, though having rather a more narrow bill, in this respect being somewhat intermediate between *Hemitriccus* and *Phylloscartes*. In coloration it differs conspicuously from *Phylloscartes ventralis* in having the abdomen white instead of yellow, and in being generally paler throughout.

POGONOTRICCUS ALLENI, new species.

Chars. sp..—Similar to *Pogonotriccus plumbeiceps*, but smaller, the yellow of lower parts deeper and more greenish, the chin yellowish instead of whitish, the auriculars with a black posterior band, the plumbeous of head somewhat darker, the green of upper surface brighter.

Description..—Type, No. 71758, American Museum of Natural History; Rio Cauca, United States of Colombia, June, 1898; J. H. Batty. Crown and occiput deep plumbeous with a slight brownish tinge; rest of upper surface bright olive green; tail fuscous, edged with olive green; wings fuscous, the lesser coverts margined with olive green, the median and greater coverts with greenish yellow, forming two wing bars, the secondaries similarly edged, the primaries more narrowly with the same color; lores and ill-defined superciliary stripe grayish white, mixed with slaty plumbeous; eye ring grayish white; subocular area mixed plumbeous and whitish; anterior auriculars dull sulphur yellow, this succeeded posteriorly by a black band; supra-auricular region with a dull white spot, contiguous to the end of superciliary stripe; sides of neck olive green like the back; entire lower surface deep greenish yellow, clearest posteriorly, much overlaid with olive green on the breast, duller and paler on the chin and upper throat; axillars and under wing-coverts pale yellow; inner margins of wing-quills yellowish white. Wing, 57 mm.; tail, 52 mm.; exposed culmen, 8 mm.; tarsus, 14.5 mm.; middle toe, 7.5 mm.

The single specimen on which this new species is based was originally identified as *Pogonotriccus plumbeiceps*, but it so greatly differs from that species, with the type of which it has been compared, that there is not the slightest doubt of its distinctness; and furthermore it seems not to agree with any described form. In general appearance it is a much brighter colored bird than *P. plumbeiceps*, this particularly conspicuous on the upper parts and about the head. There is much more blackish and slaty on the sides of the head; the more deeply yellowish wing margins are broader; the anterior ear-coverts are deep yellow; the crissum is darker yellow; the breast much more strongly shaded with olive. From *Pogonotriccus zeledoni* it differs in much the same respects, yet even more decidedly; and it may be distinguished from *P. eximius* by its larger size, slaty plumbeous crown and occiput, more yellowish edgings of the wings, slightly ashy chin and slaty mixture in the white of lores and superciliary stripe.

This fine new species is with great pleasure dedicated to Dr. J. A. Allen, through whose kindness the privilege of publishing this description is accorded, and to whom further the writer owes much for favors past and present.

SIRYSTES SIBILATOR ATIMASTUS, new subspecies.

Chars. subsp..—Similar to *Sirystes sibilator sibilator*, but slightly smaller; the upper parts lighter and more grayish; the lower surface somewhat paler; the rump distinctly whitish.

Description..—Type, adult male, No. 129412, U.S.N.M.; Chapada, Matto Grosso, Brazil, March 13, 1885: H. H. Smith. Crown and occiput dull black; upper tail-coverts dark sepia brown, edged with grayish; remainder of upper surface olive gray, the feathers with median streaks of dark brown, broadest on the back and scapulars, the rump white, washed with yellowish gray; tail blackish brown, margined with buffy; wings blackish brown, the lesser and median coverts edged with dark olive gray, rather paler on the latter, the greater series, with the secondaries, margined with grayish white; lores, cheeks, and auriculars brownish slate color; sides of neck medium gray, with a wash of greenish; chin, breast, and throat pale dull gray; rest of lower surface white, the sides washed with yellowish; under wing-coverts light gray with brownish centers; axillars pale yellow. Length of wing, 91 mm.; tail, 79 mm.; exposed culmen, 16 mm.; tarsus, 20 mm.; middle toe and claw, 12 mm.

The most conspicuous character distinguishing the present form from true *sibilator* is the distinctly whitish rump. In this respect *S. s. atimastus* approaches *Sirystes albocinereus*, but differs in the conspicuously streaked upper surface, though suggesting that *albocinereus* may ultimately prove to be only subspecifically separable.

Family TROGLODYTIDÆ.

THRYOPHILUS ALBIPECTUS BOGOTENSIS Hellmayr.

Thryophilus albipectus bogotensis HELLMAYR, Verhandl. k. k. Zool.-bot. Gesellschaft, Wien, 1901, pp. 770, 774.

Chars. sp..—Similar to *Thryophilus albipectus* Cabanis, but bill rather longer; entire upper parts, including wings and tail, very much darker; streaking on cheeks more conspicuous; sides of head and neck more grayish; throat and breast more tinged with brownish; flanks and crissum more deeply rufous.

Description..—Adult female, No. —,¹ collection of Carnegie Museum; Don Diego, Santa Marta, Colombia, May 12, 1901; Mrs. H. H. Smith. Above deep reddish brown, rather paler on rump and upper tail-coverts; tail chestnut, barred with blackish; wings fuscous, the lesser and median coverts like the back, the greater series, tertials, and external webs of other wing-quills finely barred with the same color; superciliary stripe dull white, lores and postocular stripe dull brown, the former mixed with whitish; cheeks, auriculars, and post-auricular

¹Not numbered.

region grayish white, conspicuously streaked by feather margins of dark brown; throat and breast dull brownish white, the breast laterally much tinged with ochraceous; sides of body, flanks, lower abdomen, and crissum rufous, brighter posteriorly; lining of wing dull brownish white. Length of wing, 60 mm.; tail, 42 mm.; exposed culmen, 15.5 mm.; tarsus, 23 mm.; middle toe, 15.5 mm.

The above-described species differs from *Thryophilus longirostris* of Brazil in its much shorter bill and tail, darker upper surface, more rufescent crown, conspicuous streaking of cheeks and auriculars, whitish breast and center of abdomen. It is only subspecifically distinct from *Thryophilus albipectus*, although our material does not indicate intergradation. *Thryophilus albipectus bogotensis* is evidently the bird identified as *Thryophilus leucotis* by Dr. Sharpe,¹ but is certainly not the *Thriothorus leucotis* of Lafresnaye. In the original description of *leucotis*² the cheeks are given as pure white, unmarked, which character, as well as the color of the upper parts, clearly is inapplicable to Dr. Sharpe's bird from Venezuela or to the present one from Colombia; but *leucotis* is apparently the bird now known as *Thryophilus galbraithii* Lawrence.³ Dr. Sharpe synonymizes *Thryothorus albipectus* Cabanis⁴ with his *T. leucotis*,⁵ but that they are not identical is proved by a typical specimen in the National Museum collection.

By the arrangement above indicated the South American species of the *T. leucotis* group would stand as follows:

Thryophilus leucotis (Lafresnaye) (= *T. galbraithii* Auct.).—Panama.

Thryophilus superciliaris (Lawrence).—Western Ecuador.

Thryophilus longirostris longirostris (Vieillot).—Southeastern Brazil.

Thryophilus longirostris striolatus (Spix).—Eastern Brazil (Bahia).

Thryophilus albipectus albipectus (Cabanis).—Guiana and lower Amazonia.

Thryophilus albipectus bogotensis Hellmayr.—Venezuela to Bolivia.

Thryophilus albipectus hypoleucus Berlepsch and Hartert.—Orinoco region.

Thryophilus albipectus rufiventris (Scalater).—Central and Southwestern Brazil.

Thryophilus minor (Pelzel).—Southwestern Brazil and Paraguay.

Thryophilus taniopterus Ridgway.—Lower Amazonia.

For the privilege of describing the above specimen the writer is indebted to the Carnegie Museum of Pittsburg, Pennsylvania, and to the kindness of Mr. W. E. Clyde Todd, its curator of ornithology.

¹ Cat. Birds Brit. Mus., VI, 1881, p. 207.

² Rev. Zool., 1845, p. 338.

³ Ann. N. Y. Lyc. Nat. Hist., VII, 1860, p. 320.

⁴ Schomburgk's Reis. Guian., III, 1848, p. 673.

⁵ Cat. Birds Brit. Mus., VII, 1881, p. 207.

Family ICTERIDÆ.

ICTERUS PYRRHOPTERUS COMPSUS, new subspecies.

Chars. subsp..—Similar to *Icterus pyrrhopterus pyrrhopterus*, but humeral patch ferruginous instead of chestnut.

Description..—Type, adult male, No. 60595, U.S.N.M.; Cuyaba, Matto Grosso, Brazil; J. Natterer.—Entire plumage glossy black, with the exception of a bright ferruginous wing patch involving all the superior coverts excepting the greater series. Length of wing (average of 4 specimens), 94.3 mm.; tail, 94.6 mm.; exposed culmen, 17 mm.; tarsus, 23.1 mm.

The character upon which this new form rests—that is, the much paler color of the reddish brown humeral area—is, notwithstanding some individual variation, quite constant in all of the considerable number of specimens examined. Birds from the neighborhood of Chapada, Matto Grosso, Brazil, are of the same form, but those from Corumba, farther to the southward, are true *pyrrhopterus*. Bonaparte's name *Pendulinus periporphyrus*¹ was based on the bird from Bolivia, which, as proved by specimens examined, is the same as that of Paraguay, the type locality of *pyrrhopterus*.² The present race is therefore undescribed.

ICTERUS PYRRHOPTERUS ARGOPTILUS, new subspecies.

Chars. subsp..—Like *Icterus pyrrhopterus pyrrhopterus* in color, but decidedly larger, this particularly evident in the bill and tail.

Description..—Type, adult male, No. 55749, U.S.N.M.; Conchitas, Buenos Ayres, Argentine Republic, September, 1868; William H. Hudson.—Above and below glossy black, this including both wings and tail, with the exception of a chestnut humeral patch.

Although in color not different from typical *I. pyrrhopterus*, the birds from Buenos Ayres are so much larger that their subspecific separation seems desirable. The subjoined table of millimeter measurements exhibits the difference between the two races.

Name.	Sex.	Locality.	Wing.	Tail.	Ex- posed culmen.	Tarsus.
<i>Icterus p. argoptilus</i> ³	Male	Buenos Ayres	96	105	19	24
Do.....	do	do.....	96	105	19	24
Average.....			96	105	19	24
<i>Icterus p. pyrrhopterus</i>	Male	Brazil	89	89	17	24
Do.....	do	Yungas, Bolivia	95	97	18	23
Do.....	do	Sapucay, Paraguay.....	92.5	91	17	23
Do.....	do	Corumba, Brazil.....	89	90	17	24
Average.....			91.4	91.8	17.2	23.5

¹ *Consp. Avium*, 1, 1850, p. 432.

² Vieillot, *Nouv. Dict. d'Hist. Nat.*, XXXIV, 1819, p. 543.

³ Type.

THE CASAS GRANDES METEORITE.

By WIRT TASSIN,

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HISTORY.

One hundred and forty miles southwest of Juarez, or El Paso del Norte, in the State of Chihuahua, Mexico, are the ancient Mexican ruins variously known as Casa Grande, Casas Grandes, Montezuma Casas Grandes, and Casas Grandes de Malintzin, relics of a civilization that before the Spanish invasion occupied the country as far north as Santa Fe. In this ruin certain inhabitants of a small Mexican town, near to and which takes its name from the Casas Grandes ruins, discovered a roundish mass of meteoric iron.

The news of the discovery was published by Tarayre,¹ who reported that Müller, the director of the mint of Chihuahua, during the course of an exploration of the great temple of the Casas Grandes, brought to light a lenticular mass of meteoric iron 50 centimeters in diameter, carefully wrapped in cloths similar to those enshrouding the mummies in the ancient tombs of the same locality. Later, Mr. William M. Pierson, United States vice-consul at El Paso del Norte, gave a more circumstantial account of the find in a letter² to the State Department, from which the following is taken:

A party of these Mexican mountaineers, as a matter of curious speculation, commenced excavating in the old ruins of the Montezuma Casas Grandes, each man drifting into the old ruins at separate and several points. One, Teodoro Aloverado, more fortunate than the others, drifted into a large room, in the middle of which there appeared a kind of tomb made of brick. Curiosity led this bold knight of the crowbar to renew his excavations, and when he had reached the middle of this tomb, he there found this curious mass of meteoric iron * * * carefully and curiously wrapped in a kind of coarse linen * * * Angerstein, Leroy, and myself have made up the necessary funds to purchase this rare and novel specimen, making it a mutual adventure, and have started a large mercantile wagon, capable of carrying 10,000 pounds, to transport it to this city. Our intention is to secure it for the admiration of the curious and the lovers of science. We shall have it safely lodged in the consulate within fifteen days from this date.

¹Archives de la Commission Scientifique du Mexique, Paris, III, 1867, p. 348.

²Smithsonian Report, 1873, p. 419.

The letter here cited was referred by the Assistant Secretary of State to the then Secretary of the Smithsonian Institution, Professor Henry, who took measures to secure the mass as indicated by the following extract from his reply:

It would give us great pleasure to subject a portion of the meteorite in question to an investigation in regard to its gaseous contents; and if the gentlemen who own it will present it to the Institution, we will cheerfully pay the expense of transportation.

Nothing further was heard from the mass until the centennial year, 1876, when the Institution became the possessor by gift of an uncut block of meteoric iron, purporting to be the Casas Grandes mass, exhibited among the Mexican minerals at the exposition.

DESCRIPTION.

This is a lenticular mass of iron measuring 97 by 74 by 46 centimeters (38 by 29 by 18 inches) and weighing before cutting 1,544.788 kilos (3,407 pounds). The outer surface of the mass is almost entirely covered with broad, shallow pittings, some of which, as shown in the plates, are quite large. This outer surface is more or less oxidized and in no way differs from the so-called "crust surface" of other meteoric irons containing little or no ferrous chloride.

A portion of the mass was cut for exchange and study purposes by means of a slotter. The iron machined readily and was no harder than ordinary mild steel, with about the same toughness as a low-grade nickel steel. The surface left by the tool measured 55 and 38 centimeters in the two longest diameters and was readily worked down with shop files of increasing fineness, and lastly polished with emery flour. The face thus obtained showed a few small scattered nodules and grains of troilite, the largest not over 2 centimeters in diameter and the smaller, and more numerous, not larger than a pin head. No schreibersite, carbonaceous nodules, or stony matter is visible on the polished surface. After exposure to the action of dilute nitric acid, the polished surface develops the beautiful crystalline structure shown in Plate III. Seen by reflected light, the etched surface shows numerous fine lines of a yellowish to tin white color which was found to be schreibersite. The schreibersite is in general lineally arranged and is usually only to be observed by reflected light, though occasionally it is so prominent as to stand in relief, as shown on the face of the cube here figured.

THE CHEMICAL COMPOSITION.

The turnings made by the "slotter" were cut into small pieces by means of snips and carefully washed in alcohol and ether to remove any grease or dirt that may have been present, and after thorough drying were bottled and sealed to prevent possible oxidation. A weighed amount (7.02 grams) of these washed clippings was dissolved

in aqua regia and evaporated to dryness on the water bath; concentrated hydrochloric acid was then added and the whole carefully heated until all the ferric oxide was dissolved and again brought to dryness. This operation was repeated until all the nitric acid was expelled. The residue was then dissolved in 15 cubic centimeters of hydrochloric acid, evaporated till the solution was almost sirupy, and then diluted to about 100 cubic centimeters with cold water and filtered, using the "double filter" method of J. Lawrence Smith.¹ This residue was examined and found to consist entirely of carbon. The filtrate and washings from the above were collected and made up to 1,000 cubic centimeters, and all the determinations were made in the same solution. The analysis gave:

Iron.....	95.13
Nickel.....	4.38
Cobalt.....	.27
Copper.....	trace.
Carbon.....	trace.
Phosphorus.....	.24

This corresponds to—

Nickeliferous iron.....	98.65
Schreibersite.....	1.35
	100.00

It will be observed that the analysis shows no sulphur and that the amount of carbon present was practically negligible. While it is evident that the carbon and sulphur contents would naturally vary, it was thought worth while to determine whether or not the nickel-cobalt contents were a constant or not. Accordingly successive samples, weighing as nearly as possible to 5 grams each, were put in solution and made up to a definite amount and portions containing the equivalent of 1 gram of substance taken and the nickel-cobalt contents determined by the acetate method. Each sample was treated as nearly alike as possible and the precipitation being repeated six times with each. It was found that while in certain cases the nickel-cobalt contents did not vary appreciably from the figures given above, in others the variation was considerable, and in one instance the cobalt was wanting entirely. Thus:

Constituents.	a	b	c
Nickel.....	4.38	5.02	4.50
Cobalt.....	.27	.30	.00

These figures show a wide variation in composition in different parts of a mass, the character of whose etch figures is such that it would be

¹Original Researches, p. 312.

supposed that the iron was fairly uniform. It is true that the mass itself is large, yet these samples were taken from portions whose distances from each other were so small that they could not be over 30 centimeters apart.

The conclusion seems to be obvious that a bulk analysis is of little value unless made on the entire mass, or upon a very large sample, conditions which in either case are practically impossible to comply with. Second, that mineralogical separations of as large amounts as possible, together with the study of sections, are the safest guide to the composition of a meteoric mass.

THE MINERALOGICAL COMPOSITION.

In order to arrive at the chemical and physical characters of the mineral constituents, as troilite, schreibersite, etc., separations looking to the isolation of these minerals were made.

TROILITE.

A nodule of troilite weighing 1.529 grams was carefully picked from the mass. This had a specific gravity of 4.789, a brass yellow to bronze color, hardness about that of fluorite (4 in the scale), slightly magnetic, and gave on analysis:

	Per cent.
Iron.....	63.40
Nickel.....	0.20
Sulphur.....	36.21
	<hr/>
	99.81

The mineral occurs somewhat sparingly through the mass, usually in nodules varying considerably in size and shape, the one ranging from 1 or 2 centimeters to a millimeter, the other from nearly spherical to lenticular masses, and occasionally filling veins, as shown in the plate. So far as observed the segregation of the sulphide is usually accompanied by the segregation of graphite, commonly as a very thin layer between the troilite and the iron ground mass. In no instance was there noticed a segregation of the phosphide immediately adjacent to the troilite, similar to conditions which may be observed in certain sections of the Canyon Diablo and other irons.

SCHREIBERSITE.

Successive portions of the iron, amounting in all to 150 grams, were treated with a large excess of hydrochloric acid (1 HCl. sp. g. 1.1 + 15 H₂O). The several solutions were filtered, and the residues collected and dried. The phosphide was then separated by a magnet, and 1.21 grams of small, brilliant steel-gray folia were thus collected. These were, without further examination, treated with nitric acid for analysis. It was noticed that while a portion of the material went

almost immediately into solution, the remainder was exceedingly refractory. The refractory material was washed free from acid, dried, and examined under the lens. It was found that the grains were all coated with a colorless, transparent silicate. This was saved and other portions of the iron, amounting in all to 500 grams, were treated with dilute hydrochloric acid to secure more phosphide, and, if possible, more of the siliceous mineral for identification.

The phosphide thus secured when examined under the glass showed no evidences of crystalline form, and consisted entirely of small folia and grains, strongly magnetic, and very brittle, having a specific gravity of 7.123 at 20° C., and gave on analysis:

	Per cent.
Phosphorus	15.00
Iron	64.69
Nickel	20.11
	99.80

The schreibersite occurs fairly evenly distributed over the mass in fine, hair-like lines and thin plates. It frequently parallels the taenite lamellæ, and not uncommonly occurs as minute blebs and filaments on, and probably grading into, the taenite. The more common occurrence is as fine, hair-like lines and thin plates occurring in the nickel-poor iron and between the nickel-poor and nickel-rich iron. The arrangement agrees with the general structure of the iron, and is so similar to the taenite bands that it may readily be mistaken for them. No nodules of schreibersite are known to occur, and only occasionally are the bands sufficiently distinct to show in a photograph of an etched surface as they do in the print of the cube. (Plate IV.)

TAENITE.

With considerable difficulty 1.56 grams of thin taenite lamellæ were collected and submitted to an analysis, with the following results:

	Per cent.
Iron	82.90
Nickel-Cobalt	16.64
Copper	0.04
Phosphorus	0.09
	99.77

This gives the following ratio for Fe and (NiCo):

$$\text{Fe} : (\text{Ni, Co}) = 14.80 : 2.82 = 7 : 1 = \text{Fe}_2 (\text{Ni, Co}).$$

The accepted formula for taenite being Fe_6Ni .

CARBON.

All the carbonaceous residues were collected and examined under the glass for cliftonite without success. The carbon was found to be

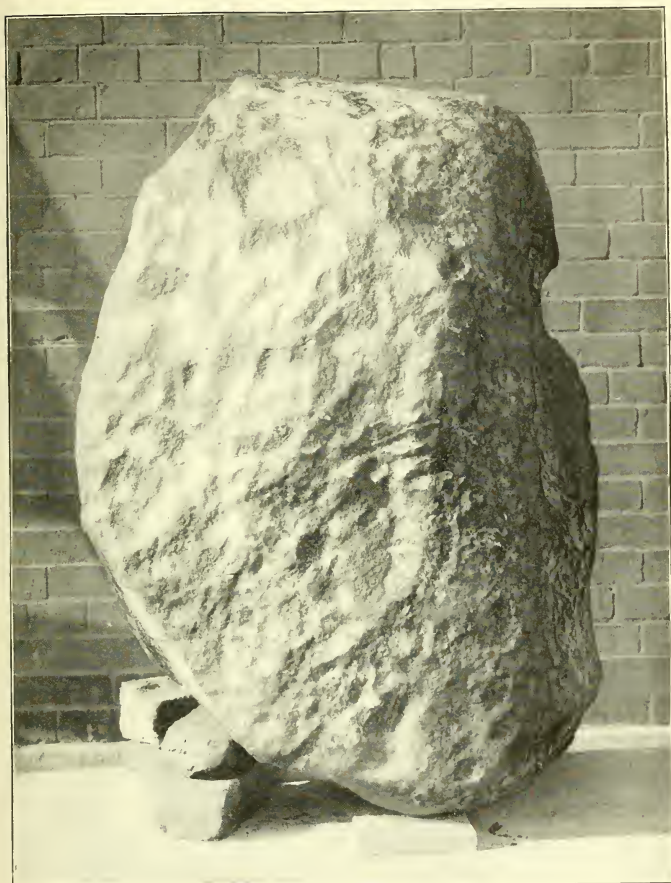
entirely in the graphitic condition. After weighing it was burned in a current of oxygen.

SILICATES AND OTHER MINERALS.

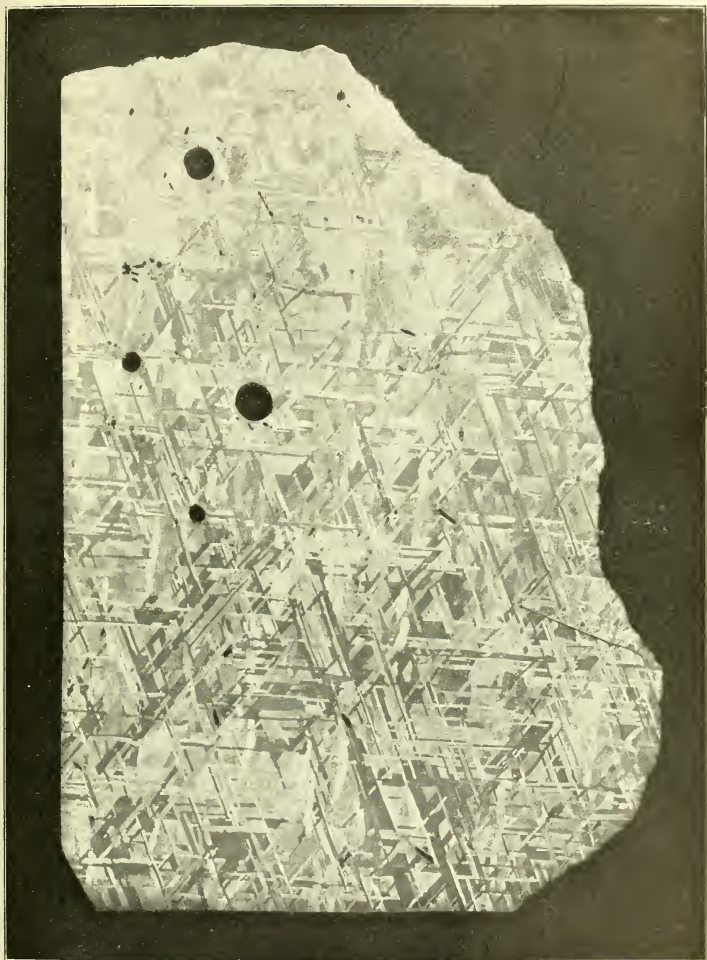
The only siliceous mineral observed was found coating a small portion of some schreibersite, and though large amounts of iron were treated for the purpose of securing more, none was found. The mineral was clear, colorless, and entirely without effect on polarized light, and not enough of it could be secured for analysis. No other minerals, such as rhabdite, cohenite, chromite, diamond, etc., were observed.



THE CASAS GRANDES METEORITE.



THE CASAS GRANDES METEORITE.



PORTION OF CASAS GRANDES MASS, ETCHED.



CUBE, ETCHED, OF CASAS GRANDES IRON.

The fine lines in relief are Schreibersite.

A REVIEW OF THE OPLEGNATHOID FISHES OF JAPAN.

By DAVID STARR JORDAN and HENRY W. FOWLER,
Of the Leland Stanford Junior University.

In the present paper is given a review of the *Oplegnathidae* found in the waters of Japan.

Family OPLEGNATHIDÆ.

Body rather short and deep, moderately compressed, covered with very small ctenoid scales; lateral line continuous; mouth small, the teeth continuous with the substance of the bones forming a sharp trenchant edge to the jaws; no teeth on palate; lower pharyngeal bones separated; gills 4; 6 or 7 branchiostegals; gill-rakers 20 or 21; gill-membranes free from the isthmus; pseudobranchiæ large. Dorsal fin with about 12 spines, the spinous portion longer than the soft, the soft fins scaly at base; anal similar to soft dorsal, with 3 spines; ventrals thoracic, I, 5; post-temporal forked, not fused with the epiotic.

A single genus with few species inhabiting the Pacific Ocean, one on the coast of Peru, two in Australia, and two in Japan. The nearest relationships of the family are apparently with the *Hæmulidæ* and other Perciform fishes, but it shows some traits of affinity with the *Chætodont* forms. The family differs from all allied forms in the united teeth, which resemble those of the Parrot fishes, although without doubt independently developed. It has no relation to any other group having fused teeth.

The following notes on the skeleton of *Oplegnathus* are given us by Mr. Edwin Chapin Starks:

The genus in certain characters resemble the *Ilarchidæ* (*Ephippidæ*), though it is much more typically percoid. It is certainly not related to the *Chætodontidæ* except as through the *Ilarchidæ*. Post-temporal forked, its lower limb short as in *Chætodipterus*, its upper limb rather loosely overlying the epiotic and not attached to it by a suture by its anterior edge.

The skull is very much like that of *Chætodipterus*, though the supraoccipital crest is not so high nor does it extend so far forward. The temporal crest extends farther forward. It does not meet the occipital crest, but stops with it at the frontals. There is a well-developed process descending from the basisphenoid which is absent in the *Chætodipterus*. Both have a process from the basisphenoid to which the

pharyngo-branchials are attached. The facial bones are in no way peculiar. The angular bone on the lower jaw is present. The maxillaries are widely separated by premaxillaries. The suborbital ring has a well-developed under shelf. The hyoid arch and shoulder girdle do not differ from the percoid type. Branchiostegals seven. Three pairs of tooth-bearing pharyngo-branchials of about equal size. Lower pharyngeals separate. Vertebrae 10 + 14 + hypural = 25. Vertebrae not crowded as in *Harchida*. Parapophyses developed on all the abdominal vertebrae except the first three. They begin abruptly and are low on the centra.

OPLEGNATHUS Richardson.

- Oplegnathus* RICHARDSON, Proc. Zool. Soc. Lond., 1840, p. 27 (*conwayi*).
Hoplegnathus RICHARDSON, Ichth. China, 1846, p. 247 (corrected spelling).
Scarodon SCHLEGEL, Fauna Japonica Poiss., 1844, p. 89 (*fasciatus*).
Ichthyorhamphos CASTELNAU, Poiss. Afrique Austr., p. 35 (*pappei*).
Scarostoma KNER, Sitzg. Ak. Wiss. Wien, 1867, p. 715 (*insigne*).

Characters of the genus included above.

(ὄπλον, armature; γνάθος, jaw.)

- a. Body with seven black cross-bands; D. XII, 17; A. III, 13; scales, 95... *fasciatus*.
 aa. Body everywhere coarsely spotted with blackish; D. XII, 15; A. III, 13; scales,
 110 *punctatus*.

OPLEGNATHUS FASCIATUS (Schlegel).

ISHIDAI¹ (STONE TAI, OR PERCH), SHIMAYOKODAI (CROSS-BANDED PERCH), YOKOSHIMADAI.

- Poisson Perroquet Noir* TILESUS, Krusenstern's Reise, 1809, pl. LI, fig. 2; near Nagasaki.
Scarodon fasciatus SCHLEGEL, Fauna Japonica, Poiss., 1844,² p. 89, pl. XLVI, figs. 1, 2; Nagasaki.
Hoplegnathus fasciatus RICHARDSON, Ichth. China, 1846, p. 247; Canton.—BLEEKER, Ichth. Fauna Japonica, 1853, p. 6; Kaminoseki.—GÜNTHER, Cat. Fish., III, 1861, p. 357; Japan.—WAITE, Records Austral. Mus., III, 1900, p. 214 (discussion of synonymy).
Hoplegnathus fasciatus STEINDACHNER and DÖDERLEIN, Fische Japans, II, 1883, p. 24; Tokyo, Kochi.—NYSTROM, Svensk. Vet. Handl., 1887, p. 38; Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 33; Nugata, Kigo.—STEINDACHNER, Reise H. M. S. Aurora, 1898, p. 214; Kobe.
Oplegnathus fasciatus JORDAN and SNYDER, Check List, 1901, p. 82; Yokohama; Hakodate.
Hoplegnathus krusensterni GÜNTHER, Zool. Record, V, 1869, p. 146, substitute for *H. fasciatus*, supposed to be preoccupied by *H. fasciatus* Krøyer (Nat. Tyds. N. R., I, 1845, p. 213), a synonym of the Peruvian species *Oplegnathus insignis*.

Head, 3; depth, $1\frac{3}{4}$ to 2; D. XI or XII, 17 to 18; A. III, 12 to 13; P. I, 16; V. I, 5; scales 17-95-50. Body deep, strongly compressed and covered with very small etenoid scales. Head moderately deep,

¹The name Tai (written dai in compound words) in Japan is applied to *Pagrus major* primarily, a most valuable and characteristic Japanese fish, sacred to the fish god Ebisu. The particle enters into the name of most perch-like fishes and corresponds to our word perch or more exactly to porgy (*Pargo*, *Pagrus*, πάγρος). Uwo in Japanese means fish.

²According to Waite, the date of the fascicle of Fauna Japonica containing the account of *Scarodon* was published in 1844.

the upper profile oblique with the snout projecting; eye rather high, $4\frac{2}{3}$ in head and $1\frac{2}{3}$ in snout; mouth moderate, the maxillary reaching below the second nostril; teeth with sharp cutting edge; lips moderately thick; interorbital space convex; gill-opening moderately long, the membrane folding over and free from the isthmus; gill-rakers moderately long and in moderate numbers; base of dorsal and anal scaled; first dorsal spine short, before the pectoral, the other dorsal spines highest in the middle and sloping behind; soft dorsal high and rounded in front, sloping downward behind; first anal spine the shortest; anal highest in front and sloping behind; pectoral deep and rounded, $1\frac{1}{2}$ in head; ventrals longer than the pectorals, their spines $2\frac{1}{2}$ in head; caudal deep, the lobes pointed and the edge emarginate; lateral line arched, high, and concurrent with the back; caudal peduncle $2\frac{2}{3}$ in the head, compressed.

Color in spirits brown, dark above, with seven dark, distinct, black, vertical bands, the first through the eye; ventrals black; caudal broadly edged with black; lower margin of the anal blackish. Length, $6\frac{2}{3}$ inches. Here described from Tokyo examples.

This species is common in the bays of southern Japan, occurring frequently in the markets and valued as food, ranking with percoid fishes generally. Our specimens are from Aomori, Tokyo, Misaki, Wakanoura, Kobe, Onomichi, Hiroshima, Tsuruga, and Hakata.

(*fusciatus*, cross-banded.)

OPLEGNATHUS PUNCTATUS Schlegel.

ISHIGAKIDAI (STONEWALL PERCH, FROM THE COLORATION); KIKOBISHA (MOVE OF THE KNIGHT IN CHESS).

Scorodon punctatus SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 91; Nagasaki.

Hoplegnathus punctatus RICHARDSON, Ichth. China, 1846, p. 247; Canton.—GÜNTHER, Cat. Fish., III, 1861, p. 358; China.

Hoplegnathus punctatus STEINDACHNER and DÖDERLEIN, Fische Japans, II, 1883, p. 24; Tokyo, Kobe, Kanagawa, Hakodate.—NYSTROM, Svensk, Vet. Handl., 1887, p. 38; Nagasaki.—ISIKAWA, Prel. Cat., 1897, p. 34; Boshu, Tokyo, Kagoshima.

Oplegnathus punctatum JORDAN and SNYDER, Check List, 1901, p. 82; Yokohama.

Hoplegnathus maculosus RICHARDSON, Ichth. China, 1846, p. 247; Canton.

Head $3\frac{1}{6}$; depth $1\frac{2}{3}$; D. XII, 15; A. III, 13; P. I, 16; V. I, 5; scales about 25–110–60. Body deep, strongly compressed and covered with very small ctenoid scales. Head moderately deep, the upper profile oblique and with the snout projecting; eye high, $4\frac{1}{2}$ in head. $1\frac{2}{3}$ in snout; mouth moderate, the maxillary reaching below the second nostril; teeth with sharp cutting edge; lips moderately thick and broad; interorbital space strongly convex; gill-opening moderately long, the membrane free over the isthmus; gill-rakers moderately long and in moderate number; base of dorsal and anal scaled; first dorsal spine short, before the base of the pectoral, the others highest

in the middle; soft dorsal high and rounded in front; spinous anal low, the first spine the shortest; soft anal highest in front, and with rounded edge; pectoral short and rounded, $1\frac{1}{2}$ in head; ventrals a little longer than the pectorals; not reaching the origin of the anal, and the spine $2\frac{1}{2}$ in the head; caudal deep, the lobes not pointed much, and its edge emarginate; lateral line arched and nearly concurrent with the back; caudal peduncle compressed, rather deep, and about $2\frac{1}{8}$ in head.

Color in spirits brown, coarsely spotted and mottled all over with blackish-brown; on the caudal, soft dorsal, and anal the spots are smaller; nostrils blackish. Length $6\frac{1}{8}$ inches. Here described from a specimen from Nagasaki. Our largest example is from Wakanoura and measures $8\frac{1}{8}$ inches.

Color in life, light olive gray with black spots.

This species occurs with the preceding in the bays of southern Japan, but in rather less abundance. Our specimens are from Tokyo, Misaki, Wakanoura, Kobe, and Nagasaki.

(*punctatus*, spotted.)

DESCRIPTIONS OF TWO NEW SPECIES OF SQUALOID
SHARKS FROM JAPAN.

By DAVID STARR JORDAN¹ and JOHN OTTERBEIN SNYDER,

Of the Leland Stanford Junior University.

In the present paper is given a description of two new species of sharks from the deeper waters of the east coast of Hondo, the main island of Japan. Both species belong to the family of Squalidae.

1. *ETMOPTERUS LUCIFER* Jordan and Snyder, new species.

Head about $4\frac{3}{4}$ in length; depth about 7; snout about $2\frac{3}{4}$ in head; eye $5\frac{3}{8}$ in head; 2 in snout, $2\frac{4}{11}$ in the width of snout, and $2\frac{9}{11}$ in the space from the tip of the snout to mouth; space between spiracles $2\frac{1}{2}$ in the width of snout.

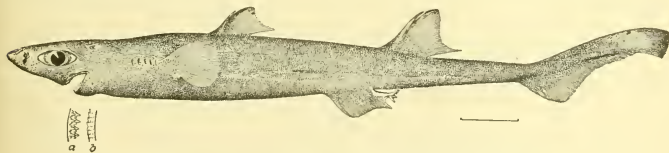


FIG. 1.—*ETMOPTERUS LUCIFER*. a, upper jaw; b, lower jaw.

Body moderately elongate, rather robust, and with slender caudal peduncle; scales rough, small, forming longitudinal striæ above, abruptly and sharply separated on the sides from the lower surface, which is evenly rough with fine shagreen.

Head large, thick, rather short; snout rather short, thick, more convex below than above, and also with many pores; eyes moderate, lateral, and with anterior margin midway between the tip of the snout and the spiracle; skin about the eyes more or less loose and free, and the upper eyelid overlapping and forming a pit in front; nostrils very large and lateral; mouth opening below the posterior portion of the

¹Assisted by Henry W. Fowler.

eye and broad; lips rather thin; teeth small, compressed, and each of those in the upper jaw with two sharp basal cups; spiracles large, nearer the eye than the first gill opening, and the space between $1\frac{1}{4}$ in the snout. Gill-opening in front of the base of the pectoral, and rather short. Dorsal fins each with a spine, the base of the first a little before the tip of the pectoral, short, sharp pointed and projecting a little above the skin; the second dorsal spine not as high as the fin, but much larger and longer than the first, with the greater portion exposed, and nearly a third greater than the snout; ventrals moderate and entirely in front of the second dorsal; caudal elongate and the lower lobe little produced.

Color in spirits dark grayish brown, and the lower margin of the caudal, together with the marginal portions of all the other fins, very pale brown. The pale areas on the sides of the belly cover a glandular substance said to be luminous in life.

This description from specimens from Misaki, measuring 12 inches, from the collection of Capt. Alan Owston, No. 6863, Stanford University Zoological Museum. Some thirty others of the same species were obtained off Misaki on long lines handled by Mr. Kumakichi Aoki, assistant to Professor Mitsukuri.

DEANIA, new genus.

2. DEANIA EGLANTINA Jordan and Snyder, new species.

Head $3\frac{3}{4}$ in length; depth about $9\frac{3}{4}$; snout about 2 in the head, 2 in the width of the snout; eye $4\frac{5}{8}$ in the head, $2\frac{5}{8}$ in the snout, and $3\frac{5}{8}$ in the space between tip of snout and mouth; space between the spiracles, $1\frac{3}{8}$ in the width of the snout.

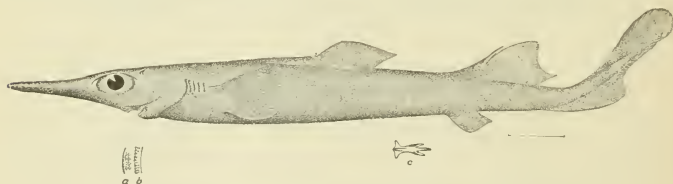


FIG. 2.—*DEANIA EGLANTINA*. a, upper jaw; b, lower jaw; c, scale (much enlarged).

Body rather elongate and slender; scales each with 3 or 4 short, radiating, bristle-like spines with two small prickles on each side, the whole body having a kind of hairy appearance, and velvety to the touch. The peculiar striated markings seen in *Etmopterus* are wanting.

Head large, greatly depressed; snout long, depressed, and broad; eyes large, lateral, and the anterior margin nearer the tip of the snout than the gill-opening; skin around the eyes more or less loose and free; nostrils large, on the lower side of the snout laterally and about midway between the tip of the snout and the eye; mouth opening

below the posterior part of the eye, and rather broad; lips moderately fleshy; teeth small, compressed, and with small basal cusp; spiracle rather large, nearer the eye than the first gill-opening and the space between a little more than the length of the snout; gill-openings in front of the base of the pectoral, the longest about half the eye.

Dorsal fins each with a spine, the base of the first a little behind the tip of the pectoral, rather short, sharply pointed, and projecting little above the skin; second dorsal spine nearly as high as the fin, and the upper half exposed; pectorals about equal to the snout; ventrals small, posterior, and entirely in front of the second dorsal spine; caudal elongate, and the lower lobe little produced.

Color in spirits uniform dark grayish brown, almost black, the tips of spinules pale.

This description from a young female from Totomi Bay, off Numazu, 12 inches in length. It was dredged by the United States Fish Commission steamer *Albatross* in 1900, and is numbered 49524 in the United States National Museum.

The genus *Deania*, named in honor of Dr. Bashford Dean, in recognition of his researches on Selachian fishes, is an ally of *Centrophorus*, from which it is distinguished by its velvety squamation, each scale ending in three or four radiating spinules arranged in the fashion of a star.



NEW DIPTERA FROM NORTH AMERICA.

By D. W. COQUILLET,
Custodian, Section of Diptera.

The present paper is based primarily on a series of specimens collected by Mr. H. S. Barber, who, as assistant to Mr. E. A. Schwarz, accompanied the latter on a collecting trip to portions of New Mexico and Arizona during the past summer. The object of this expedition was to obtain specimens of Coleoptera, and the collecting of the Diptera was therefore a digression from the real object for which the trip was planned. The Diptera thus secured are almost without exception in first-class condition, and form by far the most valuable collection in that order that the United States National Museum has acquired during the past year. Owing to pressure of other duties only a portion of the collection has as yet been worked up, but even this portion has yielded many new and interesting forms which it is deemed advisable to make known at as early a day as possible, and they are therefore duly characterized in the following pages.

To the descriptions of these new forms are added those of several others obtained from various correspondents, and for some of which manuscript names have been sent out. Altogether, 4 new genera and 94 new species are described in this paper.

Family TIPULIDÆ.

ORIMARGA ARIZONENSIS, new species.

Body and head black, head and thorax rather densely gray pruinose, abdomen very thinly grayish pruinose, slightly polished, apex of female ovipositor reddish yellow, her pleura with a whitish vitta on the lower part; male claspers very broad, about one-fourth longer than broad, bluntly rounded at the apex; antennæ and mouth parts dark brown, halteres whitish, the base yellow, the knobs pale brown; coxæ dark yellow, remainder of legs pale yellow, apex of femora, both ends of tibiae, and the tarsi toward the tips, brown; wings hyaline,

toward the base whitish, the extreme base dark yellow, venation as in Osten-Sacken's figure of *alpina*¹ with these exceptions: Apex of auxiliary vein at one-fourth of distance from base of second vein to marginal crossvein, small crossvein opposite or beyond the marginal crossvein; length 9 to 10 mm. A specimen of each sex collected June 25 and 26, 1901, by Mr. H. S. Barber.

Habitat.—Hot Springs, Yavapai County, Arizona.

Type.—Cat. No. 6154, U.S.N.M.

This European genus has not heretofore been reported from this country. The present form agrees well with the original description of this genus, except in the venation and the form of the claspers of the male.

Family CULICIDÆ.

CULEX BIMACULATUS, new species.

Bright yellow, the apices of the palpi and of the proboscis, also the antennæ except the bases, dark brown, a large black spot above insertion of each wing, apices of femora black, tarsi changing into brown toward the apices; bristly hairs and scales of head and body bright yellow, mesonotum highly polished; tarsal claws large, the front and middle ones toothed, the hind ones simple; wings hyaline, strongly tinged with yellow along the costa, lateral scales of the veins very small, interspersed with very elongate, narrow ones, petiole of first submarginal cell nearly as long as that cell, crossvein at apex of second basal cell nearly its own length from the one at apex of first basal cell; length, 5 mm. A female specimen collected June 16 by Mr. C. H. T. Townsend.

Habitat.—Brownsville, Texas.

Type.—Cat. No. 6259, U.S.N.M.

CULEX FLETCHERI, new species.

Head black, scales of occiput narrow, golden brown, on each side a patch of broad, appressed yellow ones, antennæ brown, the first joint and bases of the second and third yellow, palpi yellowish brown, proboscis black, the median portion brown; body black, metanotum brownish yellow, scales of thorax golden brown, the bristly hairs and those on the scutellum golden yellow, abdomen wholly covered with pale yellow scales; femora yellow, the apices and tibiæ blackish, the scales mixed white, yellow and black, not forming distinct bands; tarsi black, the bases yellowish brown, a band of white scales at bases of the three median joints on the front and middle tarsi, of the last four joints of the hind ones, claws very large, toothed; wings hyaline, veins yellow, scales sparse, small, those near base of wings chiefly yellowish,

¹ Monographs Diptera N. Am., IV, pl. 1, fig. 9.

the others brown, the lateral ones on first four veins and upper branch of the fifth very narrow and elongate, petiole of first submarginal cell about half the length of that cell, crossvein at apex of second basal cell about its length from the one above it; halteres yellow, the knobs brown; length, 6 mm. Two females collected by Dr. James Fletcher, for whom this unique species is named.

Habitat.—Carnduff, Assiniboia, British America

Type.—Cat. No. 6255, U.S.N.M.

CULEX SQUAMIGER, new species.

Head and its members black, middle of proboscis brownish, scales of occiput mixed golden and pale yellow, many black ones along the eyes, palpi black scaled, those at base, before the middle and at apex white; body black, scales of middle of mesonotum golden brown, those along the sides and on the pleura pale yellow, bristly hairs of thorax mostly black, those of scutellum chiefly yellow; scales of abdomen black, a large patch at base of each segment and several scales scattered over the remainder pale yellow, scales of venter pale yellow; femora and tibiae brown, the scales mixed black and yellow, not forming distinct bands, posterior side of the femora yellow and yellow scaled; tarsi black, the scales mixed black and yellow, a band of whitish scales at bases of the last four joints, claws toothed; wings hyaline, veins yellow, densely covered with rather broad mixed brown and whitish scales and with many very narrow ones in the apical third of the wing, petiole of first submarginal cell about two-thirds as long as that cell, crossvein at apex of second basal cell less than its length from the one above it; halteres yellow, the knobs marked with brown; length, 5 mm. Four female specimens.

Habitat.—Palo Alto (V. L. Kellogg), and San Lorenzo (G. Eisen), California.

Type.—Cat. No. 6256, U.S.N.M.

Family CHIRONOMIDÆ.

CERATOPOGON GLABER, new species.

Black, knob of halteres white, abdomen yellowish brown, scutellum and legs yellow, apices of hind femora, of all tibiae and joints of tarsi, also an annulus near middle of front tibiae, black, bases of front femora and an indistinct annulus beyond the middle pale brownish; eyes narrowly separated on the front, mesonotum opaque, whitish pruinose and with a brown median vitta, abdomen spatulate, somewhat opaque, narrow hind margins of the segments yellowish; legs slender, not spinose, first joint of hind tarsi nearly twice as long as the second, the last one nearly twice as long as the fourth, the claws large and of an equal size; wings bare, whitish, third vein reaching to six-sevenths

length of wing, separated from the first and not connected with it by a crossvein, apex of first near one-third length of third, fourth forks at small crossvein; length, 2 mm. Two female specimens collected by Mrs. Annie T. Slosson.

Habitat.—Biscayne Bay, Florida.

Type.—Cat. No. 6155, U.S.N.M.

CERATOPOGON INERMIS, new species.

Black, the antennæ and legs dark brown, the palpi, scutellum, halteres, and tarsi yellow; eyes rather widely separated on the front, mesonotum opaque, on the sides gray pruinose; femora slender, without spines, first joint of hind tarsi nearly twice as long as the second, last joint over three times as long as the fourth, without spines, claws large and of an equal size, no empodia; wings hyaline, bare, third vein separated from the first, ending near five-sixths length of wing, fourth vein forking slightly beyond the small crossvein; length, nearly 1 mm. A female specimen collected June 27 by Mr. H. S. Barber.

Habitat.—Hot Springs, Yavapai County, Arizona.

Type.—Cat. No. 6156, U.S.N.M.

CERATOPOGON EXILIS, new species.

Black, the mouth parts, broad margin of scutellum, legs and halteres light yellow; plumosity of antennæ whitish, mesonotum polished, legs slender, without spines, first tarsal joint about twice as long as the second, the last two of nearly an equal length, claws small, of an equal size, empodia large; wings hyaline, bare, third vein contiguous to the first, ending near two-thirds length of wing, apex of first vein near middle of the third, fourth vein forking slightly beyond the small crossvein; length, 1 mm. A male specimen collected May 15 by Mr. H. S. Barber.

Habitat.—Washington, District of Columbia.

Type.—Cat. No. 6157, U.S.N.M.

CERATOPOGON STIGMALIS, new species.

Black, the knobs of halteres light yellow, legs brown, both ends of the tibiae and whole of tarsi except apices of the joints yellow; eyes contiguous, mesonotum apparently subopaque (injured), legs slender, not spinose, first joint of hind tarsi about twice as long as the second, the fifth twice as long as the fourth, not spinose below, claws on all tarsi unequal in size, the longest almost as long as the last tarsal joint; wings hyaline, bare, third vein considerably thickened, ending near three-fifths length of wing, connected to the first by a crossvein, apex of first vein near three-fourths length of the third, costa emarginate at apex of the latter, lower branch of fourth vein obliterated except

toward its apex; length, 1 mm. A female specimen collected August 8 by Mr. H. S. Barber.

Habitat.—Las Vegas Hot Springs, New Mexico.

Type.—Cat. No. 6158, U.S.N.M.

CERATOPOGON PILOSUS, new species.

Head black, face yellowish brown, mouth parts and antennæ brown, first joint of the latter yellow, eyes contiguous, mesonotum brownish yellow, opaque, its hairs yellow, scutellum and middle of metanotum brown, pleura yellow, abdomen dark brown, bases of the segments and the venter yellow, legs yellow, not spinose, bearing many very long hairs, first tarsal joint slightly shorter than the second, the last two subequal in length; claws minute, of an equal size, empodia large; wings hyaline, wholly covered with brown hairs except those along basal half of costa and a patch at apex of third vein, which are light yellow, third vein contiguous to the first, ending at middle of length of wing, apex of first vein near two-thirds length of the third, fourth vein forking slightly beyond the small crossvein; halteres yellow; length, 1.5 mm. A female specimen collected May 3 by Mr. H. S. Barber.

Habitat.—Washington, District of Columbia.

Type.—Cat. No. 6159, U.S.N.M.

CERATOPOGON ANCORUS, new species.

Head yellow, upper half of occiput black, antennæ brown, the joints except the last one only slightly longer than broad; thorax and scutellum light yellow, mesonotum somewhat polished and marked with a large black spot, which is prolonged anteriorly in the middle and posteriorly at each hind angle, extending the entire length of the mesonotum; abdomen brown, the narrow sutures and the venter yellow; legs yellow, not spinose, first tarsal joint nearly twice as long as the second, last two joints subequal in length, claws minute and of an equal size; wings hyaline, almost wholly but sparsely covered with hairs, third vein contiguous to the first and to the costal vein, ending near middle of length of wing, fourth vein forking slightly beyond the small crossvein; halteres light yellow; length, nearly 1 mm. A female specimen collected by Mrs. A. T. Slosson.

Habitat.—Biscayne Bay, Florida.

Type.—Cat. No. 6160, U.S.N.M.

CERATOPOGON BELLUS, new species.

Head black, upper part of occiput silvery pruinose, antennæ yellow, the apices brown, plumosity yellow; body black, upper half of pleura and outer margins of scutellum except at the apex whitish; mesonotum opaque, gray pruinose, and marked with many brown dots arranged in longitudinal rows, the front end silvery pruinose and

marked with a few brown dots, abdomen partly light gray pruinose; legs slender, not setose, whitish, femora with a broad median and a narrow apical brown band, tibiae with a broad median brownish band and a narrow one at each end, first joint of hind tarsi over twice as long as the second, the third and fourth subequal in length and scarcely longer than broad, the fifth nearly twice as long as the fourth, claws rather large and of an equal size; wings bare except along the apical margin, hyaline, marked with eight black dots, situated as follows: just before small crossvein, below middle of fifth vein, before apex of each of its branches, beyond base and before apex of lower fork of fourth vein, before apex of upper fork of this vein, and at apex of third vein, the latter slightly beyond middle of length of wing, third vein contiguous to the first except toward its apex, tip of first vein near four-fifths of the third, fourth vein forks considerably beyond the small crossvein; halteres whitish, a black dot at base of the knob and another at its apex; length, 1 mm. A male specimen collected May 17 by Mr. H. S. Barber.

Habitat.—Washington, District of Columbia.

Type.—Cat. No. 6161, U.S.N.M.

CERATOPOGON SQUAMIPES, new species.

Black, knobs of halteres whitish, legs dark brown, the knees yellowish; eyes contiguous, mesonotum opaque, covered with appressed yellow hairs and with longer erect brown ones; legs rather slender, not spinose, bearing many long hairs; tibiae on the outer side bearing several lanceolate flattened bristles, first tarsal joint slightly shorter than the second, last two joints subequal in length; claws small, equal, empodia small; wings hyaline, wholly covered with hairs which are brown except a patch of yellowish ones at apex of third vein, this vein contiguous to the first, ending at middle of length of wing; apex of first vein near three-fourths length of the third, fourth vein forking considerably before the small crossvein; length, 1 mm. Three females collected August 14 and 19 by Mr. H. S. Barber.

Habitat.—Las Vegas Hot Springs, New Mexico.

Type.—Cat. No. 6162, U.S.N.M.

HETEROMYIA PRATTII, new species.

Head reddish brown, eyes rather widely separated on the front, antennae brown, the first joint and bases of several of the succeeding ones yellow, joints beyond the first noticeably longer than broad, thorax almost bare, black, the humeri and prothorax reddish brown, the sides, pleura, and metanotum sometimes reddish yellow, mesonotum somewhat polished, finely aciculate, not pruinose, prolonged anteriorly in a short spine, scutellum reddish brown, abdomen dark brown, hind margins of the first five segments yellow, somewhat polished, not

whitish pruinose except on the last two segments; legs reddish and brown, apices of middle and hind femora reddish yellow, tarsi light yellow, apices of joints and whole of fourth joint of hind ones brown, last joint of front ones white, the ends brown, front femora greatly thickened, spinose on under side, other femora and the tarsi not spinose, middle femora slender, hind ones considerably thickened toward the apices, first joint of front and middle tarsi over twice as long as the second, fourth joint less than half as long as the fifth, claws small, subequal in size, first joint of hind tarsi only slightly longer than the second, the fourth slightly over half as long as the fifth, the claws very unequal in size, the inner one about six times as long as the outer, almost as long as the last tarsal joint; wings bare, hyaline, a brown fascia extending from middle of first section of fourth vein almost to the hind margin of the wing, also a large brown spot reaching length of third vein and extending to apices of forks of fifth vein, leaving a hyaline spot below middle of third vein and in apex of fourth posterior cell; third vein connected with the first by a crossvein, reaching four-fifths length of wing, apex of first vein slightly before middle of the third, fourth vein forking slightly before the small crossvein; halteres whitish; length, 4 mm. Four females collected June 9 and 22 by Mr. F. C. Pratt, for whom the species is named.

Habitat.—St. Elmo, Virginia.

Type.—Cat. No. 6163, U.S.N.M.

TANYPUS STELLATUS, new species.

Yellowish brown, antennæ except the basal joint pale yellow, abdomen blackish, a whitish ring at three-fourths the length of each femur, tibiæ except each end, and tarsi except apices of the joints, light yellow, halteres yellow; mesonotum thinly gray pruinose; wings covered with brown hairs, whitish hyaline, marked over nearly the entire surface with many brown spots, several of which are confluent and inclose small whitish spots; costal cell except at its apex brown; first vein near its apex connected with the second by an oblique crossvein, fifth vein forks a short distance beyond the crossvein; length, 2 mm. A female specimen.

Habitat.—Texas.

Type.—Cat. No. 6164, U.S.N.M.

TANYPUS DISCOLOR, new species.

Yellowish brown, antennæ, scutellum, large portion of abdomen, legs except apices of femora and tibiæ, also the halteres, yellow; mesonotum grayish pruinose, most dense at the humeri and in front of scutellum; wings whitish hyaline, two crossbands and the apex largely brown; the first band is on a line with the humeral crossvein,

and along the costa is broadly connected with the second band which is located at the small crossvein; behind the fifth vein the second band is prolonged to meet the brown at apex of wing; the latter begins a short distance before the apices of the first and of the posterior branch of the fifth vein, and incloses a large hyaline spot in apex of the second and third posterior cells, also two yellowish costal spots; the brown along the costa comprises two spots of a darker color than the remainder of the brown at the apex of the wing, and between the first of these spots and the preceding brown band is a large yellow costal spot; wings densely covered with hairs, which are yellowish on the hyaline portions and brown on the dark parts; first vein a short distance before its tip connected with the second by an oblique crossvein, fifth vein forks slightly before the crossvein; length, 3 mm. A female specimen collected by Mrs. A. T. Slosson.

Habitat.—Franconia, New Hampshire.

Type.—Cat. No. 6165, U.S.N.M.

TANYPUS ALGENS, new species.

Yellow, three vittæ on the mesonotum, the metanotum, spots on the pleura, and the sternum, brownish black; mouth parts, apices of femora, and bases of tibiæ brownish; mesonotum grayish pruinose, the vittæ somewhat polished; wings covered with hairs, hyaline, crossed at the middle by a faint brownish band which extends from small crossvein halfway to the wingtip; first vein near its apex connected with the second by an oblique crossvein, fifth vein forks slightly before the crossvein; length, 3 mm. A female specimen collected July 9 by Prof. Trevor Kincaid.

Habitat.—Popof Island, Alaska.

Type.—Cat. No. 6166, U.S.N.M.

TANYPUS BARBERI, new species.

Male.—Yellowish white, apices and a broad band at middle of antennæ, three vittæ on mesonotum, the metanotum, spots on the pleura and the sternum, black; mouth parts, a band near bases of abdominal segments two to five, the whole of the following segments except their hind borders, also apices of femora, both ends of tibiæ, apices of first four joints of tarsi and whole of the last one, pale brownish; mesonotum opaque, gray pruinose; hairs of the antennæ pale yellowish; wings covered with hairs, hyaline, from the base to the small crossvein marked with three brown spots, one on the humeral crossvein and two behind the sixth vein; from small crossvein to wingtip are many, mostly isolated, brown spots; first vein near its apex connected with the second by an oblique crossvein, fifth vein forks slightly before the crossvein; length, 4 mm.

Female.—Like the male except that there is no black ring at middle

of antennæ, and the abdomen is dark brown, changing into yellow at the apex, the broad hind margins of the segments whitish; length, 3 mm. Four males and one female collected August 7 to 18 by Mr. H. S. Barber, for whom this fine species is named.

Habitat.—Las Vegas Hot Springs, New Mexico.

Type.—Cat. No. 6167, U.S.N.M.

TANYPUS VENUSTUS, new species.

Head black, mouth parts brown, antennæ pale yellow, middle of joints of basal half and whole of apical joint brown, the hairs brown and yellowish; thorax black, opaque, mottled with grayish pruinose spots and lines, scutellum yellowish, its narrow base, stripe in middle, and nearly whole of underside dark brown; abdomen whitish, an interrupted band on the hind end of the first five segments and nearly the whole of the following segments, brown; legs yellow, two bands near apex of each femur, one near base of each tibia, also apices of tibiae and of joints of tarsi, brown; wings covered with hairs, hyaline, marked with about eleven brown spots located at extreme base of wing, on humeral crossvein, before middle of axillary cell, beyond middle of anal cell, on the central crossveins, near middle of first posterior cell, near apex of this cell, beyond middle of the second and of the third posterior cells, and at apices of the first and of the second veins; first vein near its apex connected with the second by an oblique crossvein, fifth vein forks slightly before the crossvein; length, 4 mm. A male specimen collected August 9 by Mr. H. S. Barber.

Habitat.—Las Vegas Hot Springs, New Mexico.

Type.—Cat. No. 6168, U.S.N.M.

TANYPUS PALLENS, new species.

Male.—Head brown, mouth parts and basal joint of antennæ concolorous, remainder of antennæ yellow, the hairs brown and whitish; thorax whitish, three vittæ on mesonotum, metanotum, spots on pleura and the sternum dark yellow; abdomen pale yellow, a band near base of segments two to five and nearly the whole of the following segments, pale brownish; legs and halteres whitish; wings hyaline, covered with hairs, first vein near its apex connected with the second by an oblique crossvein, fifth vein forks slightly before the crossvein; length 2.5 mm.

Female.—Abdomen wholly yellow, otherwise as in the male; length, slightly over 1 mm.

Two males and two females collected August 6 to 11 by Mr. H. S. Barber.

Habitat.—Las Vegas Hot Springs, New Mexico

Type.—Cat. No. 6169, U.S.N.M.

TANYPUS OCCIDENTALIS, new species.

Brown, the prothorax, a spot near each humerus, and the scutellum dark yellow, legs light yellow, halteres whitish; hairs of antennæ brown and yellow; wings hyaline, bare, first vein not connected with the second by a crossvein; fifth vein forks a short distance beyond the crossvein, the latter situated nearly its length before the small crossvein; length 4.5 mm. A male specimen.

Habitat.—Colorado.

Type.—Cat. No. 6170, U.S.N.M.

TANYPUS GUTTULARIS, new species.

Head and its members dark brown, joints two to four of antennæ, apices of the other short ones, and a space before the apex, light yellow, plumosity brown, changing into whitish at the apices; thorax black, opaque, gray pruinose, mesonotum marked with three indistinct dark vittæ, the middle one divided by a median black line prolonged to the scutellum, the latter light yellow; abdomen pale yellowish, first segment with two brown vittæ, the others with a black fascia before the middle of each, hairs of each segment consisting of an anterior whorl and a posterior transverse pair of clusters; legs light yellow, coxæ black, a brown band before apex of each femur and another beyond base of each tibia, apices of tibiæ and of tarsi brown, front tarsi ciliate with several rather long hairs; wings wholly covered with hairs, whitish hyaline, from base to small crossvein marked with four brown spots, one on humeral crossvein, two in anal cell and one before apex of first basal cell, passing over the crossvein at apex of second basal cell and reaching the wing-margin, where it is greatly extended and rather faint; a brown spot at base of third vein, apex of wing from slightly before tip of first vein grayish brown and containing several whitish hyaline drops; first vein near its tip connected with the second by an oblique crossvein; halteres whitish; length, 5 mm. Two males, collected May 10 by Mr. R. W. Doane.

Habitat.—Pullman, Washington.

Type.—Cat. No. 6171, U.S.N.M.

ORTHOCLADIUS CLEPSYDRUS, new species.

Black, the extreme bases of femora and of front tibiæ, also the other tibiæ except their apices, whitish; mesonotum polished, scutellum and dorsum of abdomen opaque, velvet-like; wings hyaline, each marked with an hourglass-shaped black spot extending from one-fourth length of wing almost to apex of upper branch of fifth vein, the constricted portion lying above the forking of the fifth vein, the basal expanded portion reaching from fourth vein nearly to hind margin of wing, the apical extending from third vein almost to hind margin of

wing; legs only pubescent, first joint of front tarsi about half as long as the tibiae, fourth tarsal joint rather slender and almost as long as the fifth; length, 1.5 mm. A female specimen collected August 7 by Mr. H. S. Barber.

Habitat.—Las Vegas Hot Springs, New Mexico.

Type.—Cat. No. 6172, U.S.N.M.

ORTHOCLADIUS PLATYPUS, new species.

Black, a large dull yellowish humeral spot, halteres, trochanters, and extreme bases of femora yellow; hairs of antennae dark gray, thorax opaque, grayish pruinose; tarsi only pubescent, the fourth joint dilated, emarginate at the apex, noticeably shorter than the fifth, first joint of front tarsi three-fourths as long as the tibiae; wings hyaline, small crossveins not darker than the adjacent veins, not clouded with brown, third vein beyond its middle slightly bowing toward the costa; length, 2.5 mm. A male specimen collected July 6 by Mr. H. S. Barber.

Habitat.—Flagstaff, Arizona.

Type.—Cat. No. 6173, U.S.N.M.

ORTHOCLADIUS POLITUS, new species.

Head yellow, antennae brown, its hairs yellowish brown; thorax yellow, three vittae on mesonotum, spot below each wing, the breast and metanotum black, mesonotum highly polished, scutellum brownish yellow, polished, its base opaque blackish; abdomen yellowish brown, becoming darker toward the apex; legs brown, trochanters and extreme bases of femora yellow, middle and hind tibiae and bases of their tarsi dull yellowish, legs only pubescent, fourth tarsal joint slender, as long as the fifth, first joint of front tarsi three-fourths as long as the tibiae; wings hyaline, small crossvein not darker than the adjacent veins, third vein almost straight; halteres yellow; length, 2.5 mm. A male specimen collected June 6 by Mr. H. S. Barber.

Habitat.—Washington, District of Columbia.

Type.—Cat. No. 6174, U.S.N.M.

CRICOTOPUS VARIPES, new species.

Head and its members black, hairs of antennae gray; thorax black, mesonotum highly polished, metanotum and scutellum opaque, velvet black; abdomen velvet black, the first two segments and hind margins of the following two polished yellow, genitalia yellow; femora black, the extreme bases and trochanters yellow, front tibiae and tarsi brown, the former with a broad median white band, other tibiae and tarsi yellow, their apices brownish, legs only pubescent, first joint of front tarsi two-thirds as long as the tibiae; wings whitish hyaline, small crossvein slightly darker than the adjacent veins, third vein almost

straight; halteres yellow; length, 2.5 mm. A male specimen collected May 6 by Mr. H. S. Barber.

Habitat.—Great Falls, Maryland.

Type.—Cat. No. 6175, U.S.N.M.

CHIRONOMUS PULCHRIPENNIS, new species.

Head and antennæ yellow, apical half of last joint of the latter and the mouth parts brown; thorax opaque, greenish yellow, mesonotum marked with a pair of lateral brown vittæ behind its middle, metanotum with a pair of brown spots which approach each other posteriorly; scutellum and abdomen green, the latter with the hind margins of the segments yellowish, bases of segments six to eight and nearly the whole of the following two brown; legs whitish, the knees black, this color extending nearly to the middle of the middle and hind femora, front tibiæ four-fifths as long as the first joint of their tarsi; wings whitish, the costal cell except its apex brown, a broad brown band crosses the wing, passing over the bases of the first and third posterior cells and prolonged along the hind margin nearly to the anal angle, apex of wings broadly brown from third vein to upper branch of the fifth; halteres white; length, 4 mm. A female specimen collected by Mrs. Annie T. Slosson.

Habitat.—Franconia, New Hampshire.

Type.—Cat. No. 6176, U.S.N.M.

CHIRONOMUS VARIPENNIS, new species.

Head and body dark brown, a large dull yellowish humeral spot, antennæ except the first joint yellow, the hairs gray; thorax opaque, largely gray pruinose, narrow hind margins of abdominal segments gray pruinose; femora brown, the ends narrowly and a band before the apex of each, yellow; front tibiæ very short, yellow, the bases brown, other tibiæ brown, an indistinct yellowish ring beyond the base; front tarsi wanting, the others yellow; wings whitish, marked with eleven brown spots as follows: Three in a row behind the fifth vein, one before middle and another in middle of apical margin of third posterior cell, one in base of first posterior cell, another in the cell below it, and a third midway between the latter and the base of this cell, one in middle and another in apex of first posterior cell, also a small one in apex of second posterior cell; halteres whitish; length, 3 mm. A male specimen collected August 14 by Mr. H. S. Barber.

Habitat.—Las Vegas Hot Springs, New Mexico.

Type.—Cat. No. 6177, U.S.N.M.

CHIRONOMUS ATRIMANUS, new species.

Head yellowish brown, antennæ yellow, the last joint and the mouth parts brown; thorax and scutellum black, highly polished; abdomen somewhat polished, black, the first segment yellow, hind margins of

three to six yellowish; legs yellow, front tibiae and their tarsi black, apices of femora, both ends of middle and hind tibiae, apices of joints of their tarsi and whole of the last two joints blackish, front tibiae four-fifths as long as the first joint of their tarsi; wings strongly tinged with yellow on the basal third, followed by a wide brown band extending from costa to fifth vein, remainder of wing hyaline; halteres yellow; length, 4.5 mm. A female specimen collected May 6, 1899, by Mr. C. F. Adams.

Habitat.—Kansas City, Missouri.

Type.—Cat. No. 6178, U.S.N.M.

CHIRONOMUS PALLIATUS, new species.

Head, mouth parts, and first joint of antennae dark brown, remainder of antennae livid, the hairs gray; thorax dark brown, mesonotum opaque, a broad, yellowish median vitta on the anterior half, and a widely separated pair of gray pruinose vittae on the posterior half; abdomen opaque, velvet black, its hairs yellow; legs yellowish white, front and middle femora except their apices, also bases of hind femora brownish, middle tibiae tinged with brown, front tarsi only pubescent, front tibiae three-fourths as long as their first tarsal joint, hind tibiae and their tarsi in the male densely clothed with rather long hairs; wings hyaline, slightly tinged with yellow, small crossvein not darker than the adjacent veins, third vein almost straight; halteres whitish; length, 2.5 to 4 mm. Three males and three females collected June 12 by Mr. H. S. Barber, except one of the females, which was collected by the writer in June.

Habitat.—Washington, District of Columbia.

Type.—Cat. No. 6179, U.S.N.M.

Family BIBIONIDÆ.

BIBIO TENUIPES, new species.

Black, the ridge behind each humerus yellow, spines of tibiae reddish brown; hairs of eyes black, those on under side of head, on body, and on upper side of front and middle femora chiefly light colored, those on remainder of legs chiefly black; spines of front tibiae very unequal in size, hind tibiae only slightly dilated, the outer side almost straight; wings hyaline, strongly tinged with yellow in the costal cell and with dark gray in the marginal and first basal cells, stigma and veins dark brown, bases of the fifth and sixth veins subhyaline, small crossvein scarcely one-fourth as long as the first section of the third vein; length, 5.5 mm. A male specimen collected June 5 by Mr. H. S. Barber.

Habitat.—Williams, Arizona.

Type.—Cat. No. 6180, U.S.N.M.

SCATOPSE VARICORNIS, new species.

Head and body black, mesonotum somewhat polished, antennæ about as long as the head and thorax, black, joints three to six bright yellow, apex of the last joint with a white reflection, joint three slightly longer than wide, the succeeding joints becoming successively shorter except the last one; legs dark brown, extreme ends of femora, apices of tibiæ, and whole of tarsi yellow, broad bases of tibiæ white; wings grayish hyaline, veins brown, apex of third vein near three-fourths length of wing, penultimate section of fourth vein about two-thirds as long as the upper fork of this vein, the forks gradually diverging from each other for a short distance, at which point the upper fork is strongly bowed upward, then extends nearly parallel with the lower one nearly to the wing-margin, where they diverge rather strongly from each other, fifth and sixth veins distinct, the latter strongly sinuous; length, 1.5 mm. A female specimen collected by Mr. Th. Pergande.

Habitat.—Washington, District of Columbia.

Type.—Cat. No. 6181, U.S.N.M.

Family SIMULIDÆ.

SIMULIUM FULVUM, new species.

Male.—Head and its members dark brown, occiput covered with rather long golden-yellow hairs, thorax reddish yellow, opaque, sides of scutellum and mesonotum in front of it bearing many rather long golden-yellow hairs; abdomen dark brown, opaque, on each side of the base is a large cluster of golden-yellow hairs more than half as long as the abdomen; legs dark yellow, apices of tibiæ and whole of tarsi pale brown; halteres dark yellow; wings hyaline, veins along costa brown, the others nearly hyaline.

Female.—Differs from the male as follows: Head, except upper part of occiput and the front, dark yellow, base of antennæ also yellow, hairs of occiput short and sparse; abdomen yellowish brown or dark yellow, usually changing into brown at the apex, the hairs at its base less than one-third as long as the abdomen; tarsi and tibiæ usually yellow.

Length, about 3 mm. One male and ten females.

Habitat.—Bear Paw Mountains, Montana (September 3, H. G. Hubbard); Custer County, Colorado (T. D. A. Cockerell); Mount Cheam (August 7, J. Fletcher), Lowe Inlet (June 3, T. Kincaid) and Laggan (H. F. Wickham), British Columbia; Sitka (June 16), Virgin Bay (June 26), and Kukak Bay (July 4, T. Kincaid), Alaska.

Type.—Cat. No. 6182, U.S.N.M.

I formerly mistook this species for Walker's *ochraceum*, but the latter, besides being considerably smaller, has whitish pruinose vittæ on the mesonotum and bicolorous middle and hind tarsi.

SIMULIUM VIRGATUM, new species.

Male.—Head and body black, antennæ and mouth parts dark brown, thorax gray pruinose, mesonotum marked with a narrow median and laterally with a very broad velvet black vitta (viewed directly from above), mesonotum sparsely covered with short, appressed hairs; abdomen on first six segments opaque, velvet black, a large silvery white spot on each side of the second and sixth segments, venter near each side with an interrupted yellow vitta on segments three to seven, composed of appressed hairs, on each side of base of abdomen is a large cluster of yellow hairs, and a smaller cluster on each side of segments three to five; femora and front tibiæ yellow, their apices brown, middle tibiæ brown, a yellow ring beyond the base, hind tibiæ brown, the extreme base yellowish; tarsi black, broad base of first joint and extreme base of the second on the middle and hind tarsi light yellowish; wings hyaline, veins along the costa yellowish brown, the others nearly hyaline; halteres yellow.

Female.—Differs from the male as follows: Vittæ of mesonotum brownish, the median vitta dilated posteriorly, wider than either of the lateral ones; viewed from in front the mesonotum appears whitish pruinose and with two velvet black vittæ; abdomen on first five segments and sides of the sixth opaque, gray pruinose, and with a velvet black fascia at bases of three to six, broadly interrupted on six, the middle of which and the portion of the abdomen beyond it is very thinly pruinose and of a dark brown color.

Length, nearly 3 mm. Two males and two females collected August 4 to 14 by Mr. H. S. Barber.

Habitat.—Las Vegas Hot Springs, New Mexico.

Type.—Cat. No. 6183, U.S.N.M.

SIMULIUM GLAUCUM, new species.

Male.—Head and body black, face gray pruinose, thorax bluish gray pruinose, mesonotum marked with a narrow median and slightly wider lateral black vittæ, broad lateral margins when viewed from behind silvery white, a pair of large, subquadrate silvery spots on the front end separated by the median black vitta, which is here greatly dilated; abdomen velvet black, sides of segments two and five to nine silvery, middle of dorsum of four also silvery; venter almost wholly silvery; femora and tibiæ brown, bases of tibiæ yellow, anterior side of front ones largely silvery; tarsi black, broad base of first joint of the middle and hind ones whitish; wings hyaline, veins along the costa yellowish brown, the others nearly hyaline; halteres yellow; length, 2.5 mm. A single specimen collected April 8, 1898, by Mr. C. F. Adams.

Habitat.—Kansas City, Missouri.

Type.—Cat. No. 6184, U.S.N.M.

Family STRATIOMYIDÆ.

AOCHLETUS *OBSCURUS*, new species.

Black, a yellow interrupted fascia on upper part of face, first two joints of antennæ and a short vitta above insertion of antennæ reddish brown, halteres yellow, base of first joint of each tarsus yellowish; upper three-fourths of front somewhat opaque, densely punctured and sparsely covered with short appressed whitish hairs, the lowest fourth nearly wholly occupied by a transverse pair of highly polished gibbous spots; face and cheeks, except the narrow gray pruinose orbits, somewhat polished and covered with appressed whitish hairs; antennæ much shorter than the head, very robust, the complex third joint larger than the remainder of the antennæ, composed of three annuli of which the first two are broader than long, the third about one-third longer than broad, tapering on its apical half, slightly longer than the apical style which is composed of three joints of nearly an equal length; thorax and scutellum nearly opaque, scabrous and sparsely covered with short appressed yellowish hairs; abdomen somewhat opaque, its hairs very short, black, those on sides of first segment and on hind angles of the second, third, and fourth rather long and yellowish; wings grayish hyaline, subcostal cell and apex of costal brown, stigma and veins brown; length, 9 to 10 mm. Two female specimens.

Habitat.—Los Angeles County, California (D. W. Coquillett); and Sulphur Spring Valley, Arizona (June 6, H. G. Hubbard).

Type.—Cat. No. 6185, U.S.N.M.

EUPARYPHUS *TAHOENSIS*, new species.

Head black, lateral margins of occiput, a pair of oblique spots on middle of front near the eyes and a pair of smaller ones on lower part of face, yellow; very narrow orbits of face and cheeks, and broad sides of occiput on the lower half, white pruinose; antennæ brown, the second joint largely yellowish brown; thorax black, a yellow vitta on either side of middle of mesonotum, a second near the lateral margin broadly interrupted behind the suture and greatly expanded at its posterior end, also a yellow vitta extends from humerus to base of wing, and one on upper part of the sternopleura; scutellum yellow, the basal two-fifths black, spines yellow, their apices brown; abdomen black, the margin and an interrupted fascia on the posterior part of the fourth segment, yellow; venter black, a large median yellowish spot on the second and third segments; femora black, the apices, tibiae and tarsi yellow, a brownish ring near middle of each hind tibia; wings hyaline, veins yellowish, those issuing from the discal cell nearly colorless, third vein simple; halteres yellow; length, 6 mm. A female specimen collected by Mr. H. G. Hubbard.

Habitat.—Lake Tahoe, California.

Type.—Cat. No. 6186, U.S.N.M.

EUPARYPHUS APICALIS, new species.

Head yellow, center of occiput, an ocellar dot, a transverse pair of oval spots below middle of front and a vitta on each side of face, black; a brownish spot near center of face; front with a paler yellow spot at the middle of the sides next the eyes, another above the antennae and one back of the ocelli; head polished, the narrow orbits of the face and cheeks and broad sides of occiput on the lower half white pruinose; antennae black, the first two joints yellow; thorax black, a yellow vitta each side of middle of mesonotum, a broader one extends from humerus to the hind angle and incloses a black spot behind the suture, another along upper edge of pleura and a short one on upper part of sternopleura; scutellum yellow, the narrow basal angles and tips of spines brown; abdomen at extreme base yellow, followed by black, which area is greatly narrowed on the posterior half of the second segment and still more so on the anterior half of the third, ending at the center of this segment, remainder of abdomen reddish yellow, the margin pale yellow, a black dot in middle of front edge of the fourth segment; venter yellow, the first segment black; legs yellow, joints three and four of the tarsi brownish; wings hyaline, stigma and veins yellowish brown, third vein forked; halteres yellow; length, 7 mm. A female specimen collected by Mr. A. Koebele.

Habitat.—Siskiyou County, California.

Type.—Cat. No. 6187, U.S.N.M.

EUPARYPHUS CRUCIGERUS, new species.

Head black, the broad orbital margins of occiput, vitta on each side of front, large spot on which the antennae are inserted and large spot on each lower corner of face, connected along the eye with that on side of front, yellow; antennae brown, the second joint and base of third yellowish; thorax black, a vitta on either side of middle of mesonotum, a broader one extending from each humerus to the hind angle, interrupted behind the suture, another on upper edge of pleura in front of wing, and one on upper part of sternopleura, also a dot above hind coxa, yellow; scutellum yellow, the extreme base black; abdomen black, the margin, a spot in middle of first segment and an interrupted fascia on the posterior part of the third and fourth, yellow; venter yellow, the broad lateral margins and nearly the whole of the first and fifth segments black; legs yellow, femora except the apices, and a median ring on the hind tibiae black; wings hyaline, stigma and veins yellow, veins issuing from discal cell nearly colorless, third vein simple; halteres yellow; length, 7 mm. Five females.

Habitat.—Colorado.

Type.—Cat. No. 6188, U.S.N.M.

EUPARYPHUS ATRIVENTRIS, new species.

Differs from *E. crucigerus* as follows: Antennæ not inserted on a yellow spot, no yellow spots at lower corners of face, but the rather broad orbital margins yellow and covered with a whitish pruinosity, a yellow fascia on lower edge of front connected with the yellow vittæ on sides of front, no yellow spot in middle of first abdominal segment, the yellow fascia on the third segment three times interrupted, venter, except the margin, wholly black; length, 5 mm. A female specimen collected July 17, 1877.

Habitat.—Greeley, Colorado.

Type.—Cat. No. 6189, U.S.N.M.

EUPARYPHUS AMPLUS, new species.

Head black, the frontal triangle, broad sides of face and three vittæ near its middle, also the lower portion of occipital orbits, yellow; antennæ brown, toward the base yellowish, mouth parts yellow; thorax black, a widely separated pair of dorsal vittæ, a vitta extending from each humerus to slightly beyond the transverse suture, a large subtriangular spot on each posterior corner, a narrow vitta on upper edge of pleura, expanding in a large spot in front of wing, a spot above front coxa, a vitta on upper part of sternopleura and one or two small spots beyond its posterior end, yellow; scutellum yellow, the basal third black; abdomen black, a fascia on first segment, small, rounded spot in outer hind angles of the second, outer margin of remainder of abdomen and an oblique spot in each outer hind angle of the third and fourth segments extending at least one-third of the width of the abdomen, yellow; venter yellow, the first segment, lateral portions of the second and an interrupted fascia at bases of the third and fourth, black; coxæ black, their apices yellow, femora yellowish brown, their ends, the tibiæ and tarsi wholly yellow; wings hyaline, the costa and veins on costal half yellow, the others nearly hyaline, third vein forked; halteres yellow; length, 8.5 mm. A male specimen collected June 17, 1898, by Mr. E. J. Osler.

Habitat.—Chimney Gulch, Colorado.

Type.—Cat. No. 6190, U.S.N.M.

Family BOMBYLIDÆ.

BOMBYLIUS RECURVUS, new species.

Male.—Head and body black, front and face opaque, gray pruinose; face along the oral margin rather densely covered with pale yellow hairs mixed above with many brown ones, those on remainder of face sparse, brown, hairs of first two joints of antennæ and on the front also brown; third joint of antennæ only slightly dilated near the base;

proboscis about as long as the body; hairs of body pale yellow, a large cluster of brown ones at sides of third abdominal segment connected by a cross-band of short brown hairs which is prolonged along middle of dorsum, terminating in a small cluster at tip of abdomen; legs dark brown, under side of hind femora bearing several bristles; wings smoky brown at base, gradually changing to hyaline at the apex, second vein strongly recurved at its apex, its extreme apex nearer base of wing than the preceding part of the recurved portion, the marginal cell strongly widening from base to apex, penultimate section of lower branch of third vein from one-fourth to one-half as long as the last section, small crossvein slightly beyond middle of discal cell; halteres yellow.

Female.—Like the male except that the hairs of the face are mostly pale yellow, the short hairs of the front also of this color, and there are many brown hairs on the mesonotum.

Length, 6 to 8 mm. Two males and two females.

Habitat.—San Bernardino County (April, A. Koebele), and San Diego County (April, D. W. Coquillett), California.

Type.—Cat. No. 6191, U.S.N.M.

GERON SIGMA, new species.

Male.—Black, the halteres brown, the knobs partly or wholly pale yellow; third joint of antennae less than twice as long as the first two, elongate-ellipsoidal, about three times as long as its greatest width, a distinct notch on upper edge a short distance before the tip; face and frontal triangle grayish pruinose; proboscis about twice as long as length of head, palpi almost reaching its middle; upper side of body opaque, velvety, a transverse pair of gray pruinose spots on front end of thorax; wings hyaline, stigma pale brown, branches of third vein as long as the preceding section, the upper branch, except at its extreme base, almost straight, in consequence of which the base of the second submarginal cell is rather pointed, hind crossvein strongly bent S-shaped, small crossvein near one-third length of discal cell.

Female.—Same as the male, with these exceptions: Front on the lower edge light gray pruinose, the remainder, like the mesonotum, dark grayish black, no gray pruinose spots on the front end of the latter, scutellum light gray pruinose, abdomen brownish, the narrow hind margins of the segments light gray pruinose, stigma of wings pale grayish.

Length, 2.5 mm. Three males and seven females.

Habitat.—Alabama (C. F. Baker), North Carolina, and Colorado (H. K. Morrison). Three of the Alabama specimens were received for naming from Mr. C. W. Johnson, of Philadelphia, and have been returned to him again.

Type.—Cat. No. 6192, U.S.N.M.

Family SCENOPINIDÆ.

PSEUDATRICHIA FLAVICEPS, new species.

Head dark yellow, the occiput except the sides and an emargination behind the ocelli, an ocellar spot, and spot in middle of lower half of front, black; antennæ and mouth parts black; thorax and scutellum polished, black, a large yellow spot at inner side of each humerus, an interrupted white line below each wing, hairs of mesonotum short, depressed, brassy yellow, arranged in stripes, those of pleura white; abdomen polished, bronze black, hind margins of segments two to six, white; legs black, the knees yellow, this color most extended on the front pair; wings hyaline, veins brown, apex of second vein close to tip of first, halteres pale brown, marked with a few white streaks and dots; length, 6 mm. Two females collected July 15 by Mr. H. S. Barber.

Habitat.—Williams, Arizona.

Type.—Cat. No. 6193, U.S.N.M.

PSEUDATRICHIA PILOSA, new species.

Black, polished, dorsum of abdomen bronze color, hind margins of segments two to five white, halteres white, a blackish spot on upper side of each knob; thorax and femora covered with rather long nearly erect white hairs mixed with many black ones on the mesonotum; wings hyaline, veins brown, second vein ending close to apex of the first; length, 4 mm.—Two males collected by Mr. H. S. Barber.

Habitat.—Williams (July 7) and Hot Springs (June 28), Arizona.

Type.—Cat. No. 6194, U.S.N.M.

Family EMPIDÆ.

MYTHICOMYIA SCUTELLATA, new species.

Black, a spot above antennæ, the oral margin, corners of thorax and a vitta connecting the two on each side, a vitta on lower part of pleura, greater part of scutellum, venter, sides and hind margins of abdominal segments, halteres and knees light yellow, tarsi and apical portion of tibiae brown; face opaque, gray pruinose, front, mesonotum and abdomen polished; wings hyaline, the veins brown; third joint of antennæ oval, less than twice as long as broad, slightly over twice as long as the style; hairs of body very short and sparse; length, 1.5 mm. Seven females collected June 6 by Mr. H. S. Barber.

Habitat.—Williams, Arizona.

Type.—Cat. No. 6195, U.S.N.M.

MYTHICOMYIA PICTIPES, new species.

Differs from *scutellata* as follows: Femora and tibiae yellow, the former with a black vitta on upper side, the latter with a brown vitta

on the outer side; front and body opaque, mesonotum densely gray pruinose; third joint of antennae narrow and elongate, about four times as long as broad; length, 2.5 mm. Two females collected May 29 by Mr. H. S. Barber.

Habitat.—Williams, Arizona.

Type.—Cat. No. 6196, U.S.N.M.

RHAMPHOMYIA ALBATA, new species.

Male.—Black, the knobs of halteres, also the hairs and bristles, white; eyes contiguous, third antennal joint elongate lanceolate, nearly five times as long as the style, proboscis slightly shorter than height of head; mesonotum and abdomen polished, not pruinose, abdomen compressed, hypopygium rather small, central filament free except its apex, not fractured nor flexuous, hairs of hypopygium rather short and sparse; scutellum bearing four bristles; legs slender, nearly bare, hind tibiae bearing several short bristles on the outer side, first joint of hind tarsi considerably enlarged, over twice as thick as that of the front tarsi and with several short bristles on the upper side; wings hyaline, stigma grayish brown, sixth vein obliterated before reaching the wing margin.

Female.—With the exception of the sexual characters, like the male except that the apical portion of the wings beyond middle of discal cell is pale brown.

Length, 2.5 mm. Three males and five females collected May 29, June 2, 12, and 13, by Mr. H. S. Barber.

Habitat.—Williams, Arizona.

Type.—Cat. No. 6198, U.S.N.M.

Family CESTRIDÆ.

CUTEREBRA HISTRIO, new species.

Black, the abdomen steel-blue, apical portion of arista whitish; front somewhat opaque, very thinly grayish pruinose, the ocellar triangle and orbits polished, the latter marked with a gray pruinose spot near the middle and another at lower angle of front, a smaller spot near upper corner of facial depression, hairs of upper part of front chiefly black, on remainder largely white; face and cheeks densely gray pruinose, each side of face marked with four polished streaks, one of which is in lower part of facial depression, the other three extend inward from the eye, the upper one subtriangular and almost reaching the facial depression, the middle one almost reaching lower end of facial depression, then curving downward and extending parallel with the oral opening, reaching slightly farther backward than middle of cheek, the lowest streak joins the second near lower corner of facial depression, and a short distance from this junction it emits a broad but short branch toward the under side of the head; a velvet black streak on

either side of middle of facial depression, hairs of face and of cheeks white; mesonotum and scutellum opaque, bluish gray pruinose, the hairs black, a stripe of white ones above each wing, those of the pleura also white except a cluster of black ones near the upper edge; dorsum of first three abdominal segments polished, the sides, venter, and entire fourth segment densely gray pruinose but leaving several, mostly circular, polished spots; on bases of the second and third segments the gray pruinosity encroaches considerably on the dorsum. hairs of abdomen black; basal half of femora and tibiae largely, also extreme apices of tibiae, grayish pruinose, hairs black, a few white ones on upper side of middle femora and many on posterior side of front ones; wings and calypteres dark brown; length, 18 mm.; width of vertex, 3 mm.; width of head, 8 mm. A female specimen collected by Dr. A. Dugès.

Habitat.—Guanajuato, Mexico.

Type.—Cat. No. 6199, U.S.N.M.¹

Family TACHINIDÆ.

MEIGENIELLA, new genus.

Near *Cryptomeigenia* but the first vein beyond apex of auxiliary is distinctly bristly and the vibrissæ are nearer to the anterior edge of the oral margin. Head at vibrissæ much shorter than at base of antennæ, ocellar bristles directed obliquely forward, frontals in a single row each side, descending to base of third antennal joint, sides of face each about one-third as wide as the median depression, bearing a few short hairs, antennæ four-fifths as long as the face, the third joint nearly four times as long as the second, arista thickened on the basal fourth, the penultimate joint slightly longer than broad, facial ridges bristly on the lowest fourth, cheeks about one-fourth as wide as the eye height, eyes bare, proboscis short and robust, palpi clavate, well developed; first posterior cell open, ending at the wing tip, bend of fourth vein rounded, without an appendage, hind crossvein much nearer the bend than to the small crossvein, last section of fifth vein less than one-third as long as the preceding section; hind tibiae not ciliate with bristles. Type, the following species:

MEIGENIELLA HINEI, new species.

Head yellow, occiput and sides of front black, bluish gray pruinose, frontal vitta dark brown, face whitish pruinose, antennæ and base of

¹ *Cuterebra lepivora* Coquillett. Suspecting that the types of this species, a male and a female, were injured by "greasing," they were immersed for twenty-four hours in chloroform, and this had the effect of restoring most of the normal markings. The head of the male, instead of being "destitute of light-colored pollen," as described, has spots of this kind almost as in the male of *C. americana*, while the pollen of the face and cheeks of the female is whitish instead of being brownish, as stated in the original description.

arista yellow, remainder of arista dark brown, vertex two-thirds as wide as either eye, two pairs of proclinate orbital bristles, palpi yellow, proboscis yellowish brown; thorax and scutellum black, bluish gray pruinose, the former with four black vittæ, three pairs of postsutural dorsocentral bristles and three sternopleurals, scutellum bearing three marginal pairs; abdomen yellow, a broad black dorsal vitta, nearly wholly yellowish gray pruinose, first segment with marginal, the two following with marginal and discal, the fourth nearly wholly but sparsely covered with bristles; coxæ, femora, and tibiæ yellow, tarsi brown; wings hyaline, third vein bearing three bristles near the base, costal spine minute, calypteres whitish; length 7 mm. A female specimen collected May 29, 1899, by Prof. J. S. Hine, for whom the species is named.

Habitat.—Hanging Rock, Ohio.

Type.—Cat. No. 6200, U.S.N.M.¹

ADMONTIA LIMATA, new species.

Black, including the palpi; vertex four-fifths as wide as either eye, uppermost pair of frontal bristles directed outward, two pairs of orbital bristles, frontals descending slightly below base of antennæ, sides of face bearing many macrochaeta and bristly hairs not arranged in rows, face and sides of front whitish pruinose, two or three small bristles above each vibrissa, antennæ almost as long as the face, the third joint four times as long as the second, its lower front angle slightly produced in the form of a blunt tooth, arista rather long pubescent, thickened on the basal third, cheeks one-third as broad as the eye height; body polished, the humeri and bases of the second and third abdominal segments whitish pruinose, three sternopleural bristles, scutellum bearing four marginal pairs, the last pair cruciate, abdomen with discal and marginal bristles on each segment; front tarsi not dilated, their pulvilli elongated; wings subhyaline, second basal and anal cells yellowish, costal and marginal cells smoky brown, third vein bearing two bristles near the base; calypteres yellowish; length 4.5 to 5 mm. Ten males, collected by Prof. J. M. Aldrich.

Habitat.—Moscow, Idaho.

Type.—Cat. No. 6202, U.S.N.M.

¹*Alophora fenestrata* Bigot. The type was from Nevada, while the specimens referred to this species in my Revision of the Tachinidae, page 46, were from New Hampshire. A specimen from Moscow, Idaho, since received from Prof. J. M. Aldrich, agrees better with Bigot's original description, and probably belongs to the species he had before him; this specimen, however, belongs to the genus *Phoranthia*, and the wings have a much more vittate appearance than the New Hampshire specimens. The latter will therefore require a new name, for which *splendida* is proposed.

Type.—Cat. No. 6201, U.S.N.M.

PARADMONTIA, new genus.

Near *Admontia*, but the first vein bristly, first posterior cell closed far from the wing margin, etc. Head unusually short, nearly twice as high as long, slightly shorter at vibrissæ than at base of antennæ, ocellar bristles proclinate, frontals descending to apex of second antennal joint, sides of face each about one-sixth as wide as the unusually large facial depression, bearing two rows of macrochaetae, vibrissæ widely separated, inserted on a level with anterior edge of oral margin, ridges bristly on lowest fourth, antennæ of male as long as face, the third joint about eight times as long as the second, in the female about two-thirds as long as the face, the third joint three times as long as the second, arista bare, in the male thickened on the basal four-fifths, the penultimate joint twice as long as wide, in the female thickened on the basal three-fifths, the penultimate joint one and one-half times as long as wide, eyes sparsely hairy, cheeks as wide as the eye height, proboscis short and robust, palpi clavate: first vein bristly on the basal half, the third bristly nearly to the small crossvein, third vein ending close to the extreme tip of wing, first posterior cell closed, its petiole three-fourths as long as the hind crossvein, the latter nearer to small crossvein than to bend of fourth vein, this bend somewhat angular and sometimes with a short stump of a vein. Type, the following species:

PARADMONTIA BREVIS, new species.

Black, the palpi yellow: vertex about twice as wide as either eye, three pairs of orbital bristles; mesonotum light gray pruinose and marked with four black vittæ, three pairs of postsutural dorsocentral bristles, two sternopleurals, scutellum bearing three marginal pairs, the third pair diverging; abdomen very short and broad, bases of last three segments gray pruinose, the bristles very short, a marginal pair on the second and third segments, the fourth almost wholly covered; hind tibiæ not ciliate, front pulvilli of male rather short, front tarsi of female dilated, the pulvilli very short; wings hyaline, calypteres whitish; length, 3 mm. A specimen of each sex collected by Mrs. Annie T. Slosson.

Habitat.—Biscayne Bay, Florida.

Type.—Cat. No. 6203, U.S.N.M.

NEÆRA LONGICORNIS, new species.

Black, the base of the third antennal joint and the palpi yellow; vertex twice as wide as either eye, two pairs of orbital bristles, frontals descending to the arista, facial ridges only slightly arcuate, bristly almost to the lowest frontals, facial depression excessively broad, sides of face very narrow, antennæ almost as long as face, the third joint six

times as long as the second, arista thickened on the basal four-fifths, the penultimate joint nearly half as long as the last one; thorax gray pruinose, three pairs of postsutural dorsocentral bristles, two sternopleurals, scutellum bearing four marginal pairs, the second and fourth very small; abdomen polished, narrow bases of last three segments whitish pruinose, second segment bearing a discal pair and marginal row of bristles, third with a discal and a marginal row, fourth with three rows; tarsi not dilated; wings hyaline, the base tinged with yellow, third vein bearing a bristle near the base, hind crossvein slightly nearer small crossvein than bend of fourth vein, calypteres whitish; length, 4 mm. A female specimen collected August 4, 1896, by Prof. C. A. Sheldon.

Habitat.—Oswego, New York.

Type.—Cat. No. 6204, U.S.N.M.

This European genus has not heretofore been reported from this country; in the table of genera given in my Revision of the Tachinidae it would fall in with *Clausicella*, from which it will be distinguished by the bristly facial ridges.

CHÆTOPHLEPS POLITA, new species.

Black, including the palpi; vertex three-fourths as wide as either eye, no orbital bristles, frontals descending slightly below the arista, facial ridges ciliate nearly to lowest frontals, face in profile very convex, the sides below very narrow, about one-eighth as wide as the very large, subtriangular facial depression, antennæ almost as long as the face, the large third joint about six times as long as the second, arista thickened nearly to the middle, the penultimate joint slightly longer than broad, sides of front and face grayish pruinose, proboscis short and robust; mesonotum polished, three vittæ in front of the suture and the sides whitish pruinose, three pairs of postsutural dorsocentral bristles, two sternopleurals, scutellum bearing three long marginal pairs, the last pair diverging; abdomen polished, each segment bearing marginal, the last three also with short discal macrochaetæ; front claws and pulvilli very short, hind tibiae not ciliate; wings hyaline, first vein bearing three bristles on the apical third, the third bearing five near base, extending halfway to the small crossvein, hind crossvein midway between the small and the bend of the fourth, the latter arcuated, calypteres whitish; length, 3.5 mm. A male specimen collected by Prof. J. M. Aldrich.

Habitat.—Brookings, South Dakota.

Type.—Cat. No. 6205, U.S.N.M.

PELATACHINA LIMATA, new species.

Differs from my description of *pellucida*¹ as follows: Face yellowish gray pruinose, thorax marked with four black vittæ, abdomen pol-

¹ Revision of the Tachinidae, p. 65.

ished, basal portions of last three segments thinly whitish pruinose, wings yellowish brown at base and along most of the veins, third vein bearing three bristles near the base, first posterior cell closed slightly before the wingmargin, costal spine very large; length, 8 mm. A female specimen collected by Prof. J. M. Aldrich.

Habitat.—Lewiston, Idaho.

Type.—Cat. No. 6206, U.S.N.M.

PSEUDAPINOPS, new genus.

Near *Apinops*, but the palpi wanting. Head at vibrissæ noticeably shorter than at base of antennæ, vibrissæ on a level with anterior edge of oral margin, facial ridges bristly nearly to the middle, cheeks almost one-third as broad as the eye height, sides of face bare, at narrowest part about one-tenth as wide as the median depression, antennæ of male nearly as long as the face, the third joint three times as long as the second, in the female two-thirds as long as face, the third joint scarcely longer than the second, arista bare, thickened on the basal half, the penultimate joint slightly longer than broad, eyes bare, frontal bristles descending below middle of second antennal joint, ocellar bristles directed obliquely forward and outward, proboscis short and robust, third vein with a few bristles near the base, other veins bare, first posterior cell open, ending just before the wingtip, bend of fourth vein arcuate, without an appendage, hind crossvein midway between the small and the bend. Type, the following species:

PSEUDAPINOPS NIGRA, new species.

Black, the antennæ and proboscis dark brown; vertex one and one-third times as wide as either eye, front not pruinose, face thinly whitish pruinose; one pair of orbital bristles, uppermost pair of frontal bristles directed outward; body not pruinose, three pairs of post-sutural dorsocentral bristles, two or three sternopleurals, scutellum bearing three long marginal pairs, no discal bristles; abdomen depressed, ellipsoidal, the hairs very short and depressed, the bristles also short, none on dorsum of first two segments, a few marginal ones on the third and several on posterior half of the fourth; legs robust, bristles few and short, claws and pulvilli short; wings nearly hyaline, costal and marginal cells tinged with pale brown, calypteres whitish; length, 5 mm. Fifteen males and two females collected by Prof. J. M. Aldrich.

Habitat.—Moscow, Idaho.

Type.—Cat. No. 6207, U.S.N.M.

HYALOMYODES DORSALIS, new species.

Male.—Black, the mouth parts dark brown; eyes almost contiguous, the frontal vitta obliterated for a short distance; mesonotum and scu-

tellum somewhat polished, not pruinose; abdomen gray pruinose, the first segment, a streak in posterior corners of the second and third, a median spot on front end of the last three segments and a dot at base of each bristle and hair, polished black; wings hyaline, calypteres whitish; length, 3 mm.

Female.—Vertex one and one-half times as wide as either eye; body gray pruinose, a small brownish median spot on the last three abdominal segments and a brownish streak in the hind angles of the second and third, indistinct brownish dots at bases of the hairs and bristles; length, 4 mm.

A specimen of each sex collected by Prof. J. M. Aldrich.

Habitat.—Moscow, Idaho.

Type.—Cat. No. 6208, U.S.N.M.¹

OESTROPHASIA CALVA, new species.

Yellow, the thorax brownish yellow, a spot above the neck, and in the male a transverse row of three spots behind middle of mesonotum, black; abdomen in the male with a median spot on each segment and a streak at the hind angles of the last three, in the female with hind margins of first three segments and one to three spots on the fourth, black; vertex in male as wide as distance between the two posterior ocelli, only one row of about five bristly hairs outside of the frontals; in the female the vertex is slightly over twice as wide as either eye, one row of bristly hairs outside of the frontals, and outside of this a second row of four orbital bristles; thorax slightly, the abdomen highly, polished, hairs of abdomen short, depressed, first two segments with a marginal pair of bristles, third with a marginal row, the fourth nearly wholly covered on the apical half; wings whitish hyaline, the base to discal cell and in front of fourth vein to apex of first, yellowish brown, a brown crossband begins in apex of marginal cell and extends, greatly narrowed, over the hind crossvein where it turns basally along fifth vein, covering slightly over the apical half of the discal section; third vein bristly less than half way to small crossvein, first posterior cell closed at the wingmargin; length, 6 mm. One male and two female specimens.

Habitat.—Williams, Arizona (July 17, H. S. Barber); and Ottawa, Canada (W. H. Harrington).

Type.—Cat. No. 6209, U.S.N.M.

¹*Hyalomyodes triangulifera* has not been described in the female sex; the vertex is as wide as either eye, the body opaque, gray pruinose, that on the first abdominal segment very thin and not concealing the ground color, the hind margin of the second segment and a dot at base of each bristle and hair polished black.

Leucostoma neomexicana was not known to me in nature when the Revision of the Tachinidae was published; on page 69 it was given as a synonym of *senilis*, but it is evidently distinct, and will readily be recognized by the white pruinose last two abdominal segments.

OESTROPHASIA SETOSA, new species.

Female.—Differs from *calva* as follows: Mesonotum with a transverse row of three black spots behind the middle, fourth abdominal segment black on more than the apical half, base of first segment black in the middle of upper edge, a broad black dorsal vitta, passing over the broad black hind margins of the first three segments; second segment bearing a scattered median cluster of eight bristles which extends nearly to the middle of the length of the segment, third with a cluster of eight in front of the marginal row, the fourth covered except at the base; third vein bristly almost to the small crossvein; length, 6 mm. A female specimen collected by H. K. Morrison.

Habitat.—Colorado.

Type.—Cat. No. 6210, U.S.N.M.

EXORISTOIDES HARRINGTONI, new species.

Black, the face and apex of proboscis yellowish, first two joints of antennae and the palpi yellow; vertex one and one-half times as wide as either eye, one pair of orbital bristles and between each bristle and the frontals is an outwardly directed bristle, frontals descending to the arista, the latter thickened on the basal half, the penultimate joint shorter than broad, antennae nearly as long as the face, the third joint five times as long as the second, eyes sparsely hairy, cheeks one-third as wide as the eye height; thorax grayish pruinose, the vittae indistinct, three pairs of postsutural dorsocentral bristles, three sternopleurals, scutellum bearing four marginal pairs, the last pair cruciate; abdomen polished, the bases of the last three segments grayish pruinose, these segments bearing discal and marginal bristles; wings hyaline, a gray cloud at base of discal cell, a brown crossband extends from apex of first vein to slightly below the small crossvein; first vein wholly bristly, the third from its base to beyond apex of discal cell, first posterior cell closed and short petiolate, ending slightly before apex of wing, bend of fourth vein rectangular and with a short stump, hind crossvein nearer the small than to bend of fourth; calypteres whitish; length, 4 mm. A female specimen collected by Mr. W. Hague Harrington, for whom this fine species is named.

Habitat.—Ottawa, Canada.

Type.—Cat. No. 6211, U.S.N.M.

EXORISTA TRISETOSA, new species.

Black, including the palpi; vertex of male one and one-half, of female twice, width of either eye, two pairs of orbital bristles in female, frontals descending to the arista, antennae slightly shorter than the face, the third joint two and one-half times as long as the second, arista thickened to the middle, facial ridges bristly on the lower two-fifths, cheeks one-fifth as wide as the eye height; proboscis rather

slender, the labella small; thorax gray pruinose, marked with four black vittæ, three pairs of postsutural dorsocentral bristles, three sternopleurals, scutellum bearing four marginal pairs, the last pair directed backward; abdomen polished, bases of last three segments thinly gray pruinose, first segment with marginal, the following two also with discal, the last one nearly covered with rather long bristles; middle tibiæ each bearing two or three long bristles on the outer-anterior side, hind tibiæ somewhat unevenly ciliate on the outer-anterior side, wings hyaline, third vein with three or four bristles near the base, calypteres white; length, 5 to 7 mm. Seven males and one female collected August 26, 1895, by Prof. J. M. Aldrich.

Habitat.—Moscow and Lewiston, Idaho.

Type.—Cat. No. 6212, U.S.N.M.

NEMORÆA SETIGERA, new species.

Black, the face, palpi, and fourth abdominal segment yellow, apex of proboscis dark brown; vertex slightly narrower than either eye, two pairs of orbital bristles, frontals descending to the arista, sides of front on lower part, face and cheeks golden yellow pruinose, a few bristles above each vibrissa, cheeks one-fifth as broad as the eye height, antennæ slightly shorter than the face, the third joint very broad, twice as long as the second, arista thickened to the middle, the penultimate joint slightly longer than broad, proboscis rather slender, labella narrow; body slender, thorax gray pruinose, marked with four black vittæ, three pairs of postsutural dorsocentral bristles, three sternopleurals, scutellum bearing four marginal pairs, the last one the smallest, cruciate; abdomen thinly gray pruinose on the first three segments, the second and third bearing basal, discal, and marginal bristles; front tarsi distinctly dilated, middle tibiæ bearing four bristles on the outer-anterior side, hind tibiæ not ciliate; wings hyaline, crossveins not clouded, third vein bearing four bristles near the base, first posterior cell closed in the margin, hind crossvein near the bend of the fourth, the latter rectangular and with a long stump, calypteres white; length, 10 mm. A female specimen collected August 15, 1897, by Prof. J. S. Hine.

Habitat.—Medina, Ohio.

Type.—Cat. No. 6213, U.S.N.M.

PHOROCERA STERNALIS, new species.

Black, the scutellum except at base, and a spot on sides of second abdominal segment of male, yellow; vertex of male nearly as wide as, in the female one and one-fourth times as wide as, either eye, two pairs of orbitals in the female, frontals descending almost to the arista, the latter thickened on the basal half, the penultimate joint slightly longer than broad, antennæ almost as long as the face, the third joint in the male very broad, four times as long as the second, in the female three

times as long as the second, sides of front and face bluish gray pruinose, facial ridges bristly on the lower three-fourths, cheeks about one-seventh as broad as the eye height, proboscis short and rather robust; thorax grayish pruinose and marked with four black vittæ, four pairs of postsutural dorsocentral bristles, four sternopleurals, scutellum bearing four marginal pairs, the last pair directed backward; abdomen polished, the last three segments except the narrow hind margins thinly grayish pruinose, all with marginal, the second and third also with discal, the fourth wholly covered with bristles; hind tibiæ somewhat unevenly ciliate with bristles, middle tibiæ bearing three or four large ones on the outer-anterior side, front pulvilli of male as long as the last tarsal joint; wings hyaline, third vein bearing two bristles near the base, first posterior cell broadly open, calypteres white; length, 7 to 8 mm. One male and two females.

Habitat.—Franconia, New Hampshire (Mrs. A. T. Slosson); Eddington, Maine (Dr. G. de N. Hough); and Moscow, Idaho (J. M. Aldrich).

Type.—Cat. No. 6214, U.S.N.M.¹

FRONTINA SETIPES, new species.

Black, the palpi yellow; vertex one and one-fourth times as wide as either eye, frontal bristles descending slightly below the arista, the two upper pairs stout, reclinate, sides of front yellowish gray, the face whitish gray pruinose, facial ridges bristly on the lower two-thirds, antennæ somewhat shorter than the face, the third joint three and one-half times as long as the second, arista thickened on the basal third, the penultimate joint slightly longer than broad, cheeks one-fourth as broad as the eye height, proboscis short and very robust; thorax bluish gray pruinose, marked with four black vittæ, three pairs of postsutural dorsocentral bristles, three sternopleurals, scutellum bearing four marginal pairs, the last one the smallest, cruciate, almost vertical; abdomen on last three segments densely gray pruinose and with darker reflecting spots, first segment and narrow hind margins of the others polished black, all with marginal, the fourth also with discal bristles; hind tibiæ somewhat unevenly ciliate, middle tibiæ bearing two long and three short bristles on the outer-anterior side, front pulvilli slightly longer than the last tarsal joint; wings hyaline, third vein bearing four bristles near the base, calypteres white; length, 8 mm. A male specimen collected by Prof. J. M. Aldrich.

Habitat.—Brookings, South Dakota.

Type.—Cat. No. 6216, U.S.N.M.

¹*Phoroocera parva* Bigot. The type has been studied by Dr. F. Brauer, who says that it belongs to the genus *Paradoria*. The form referred to this species in my Revision of the Tachinidae, page 103, will therefore require a new name, for which *erecta* is proposed; in this species the apical pair of scutellar bristles is directed almost vertically.

Type.—Cat. No. 6215, U.S.N.M.

STURMIA LIMATA, new species.

Black, the palpi yellow; vertex slightly wider than either eye, the two upper pairs of frontal bristles reclinate, much longer than the others, sides of front grayish, the face whitish pruinose, frontals descending nearly to apex of second antennal joint, vibrissæ slightly above front edge of oral margin, ridges bristly nearly to middle, antennæ five-sixths as long as the face, the third joint two and one-half times as long as the second, narrow, arista thickened to middle, the penultimate joint shorter than broad, cheeks one-fifth as broad as the eye height, proboscis rather slender, labella small; thorax gray pruinose, marked with four black vittæ, four pairs of postsutural dorsocentral bristles, four sternopleurals, scutellum bearing four marginal pairs, the last one cruciate and nearly vertical; abdomen polished, the second segment thinly gray pruinose, the following ones except their bases velvety, first three segments with marginal bristles, the fourth with a marginal and submarginal row; hind tibiæ rather evenly ciliate, middle tibiæ bearing two bristles on the outer-anterior side, front pulvilli slightly shorter than the last tarsal joint; wings hyaline, third vein bearing four bristles near the base, fourth vein beyond the bend nearly straight, calypteres white; length, 7 mm. Two males.

Habitat.—Opelousas, Louisiana (April, 1897, G. R. Pilate), and Ohio.

Type.—Cat. No. 6217, U.S.N.M.

STURMIA AUSTRINA, new species.

Black, the palpi yellow; vertex of male one-half, of female nearly as wide as either eye, frontals descending to the arista, two pairs of orbitals in female, sides of front grayish, face whitish pruinose, vibrissæ on a level with front edge of oral margin, ridges bristly nearly to middle, cheeks one-tenth the eye height, antennæ almost as long as the face, the third joint of male five, of female four times as long as the second, arista slightly thickened on the basal third, the penultimate joint scarcely longer than broad, proboscis short and robust; thorax gray pruinose, four black vittæ, four pairs of postsutural dorsocentral bristles, three sternopleurals, scutellum bearing four marginal pairs, the last one very short and nearly horizontal; abdomen gray pruinose on broad bases of the last three segments, the second and third with marginal, the fourth almost wholly covered with bristles; hind tibiæ ciliate, middle tibiæ bearing one bristle on the outer-anterior side, front pulvilli of male slightly longer than the last tarsal joint; wings hyaline, third vein bearing a single bristle near the base, fourth vein beyond the curve nearly straight, calypteres white; length, 4.5 to 5.5 mm. A specimen of each sex bred from a Pyralid by Dr. H. G. Dyar.

Habitat.—Nassau, Bahama Islands.

Type.—Cat. No. 6218, U.S.N.M.

STURMIA DISCALIS, new species.

Black, the palpi yellow; vertex nearly twice as wide as either eye, two pairs of orbital bristles, frontals descending to apex of second antennal joint, antennae nearly as long as the face, the third joint about five times as long as the second, arista thickened on the basal fourth, the penultimate joint shorter than broad, cheeks one-fourth as wide as the eye height, vibrissae on a level with front edge of oral margin, facial ridges bristly on the lowest fourth, proboscis rather slender; thorax gray pruinose, marked with four black vittae, three pairs of post-sutural dorsocentral bristles, three sternopleurals, scutellum bearing three pairs of large marginal bristles, the last pair diverging, directed backward; abdomen yellowish gray pruinose, the broad apices of the last three segments polished, each segment bearing marginal, the last three also with discal bristles, venter depressed, destitute of short, backwardly curving spines in the middle; hind tibiae unevenly ciliate, middle tibiae bearing a single bristle near the middle of the outer-anterior side; wings hyaline, third vein bearing two bristles near the base, calypteres white; length, 8 mm. A female specimen.

Habitat.—Wisconsin.

Type.—Cat. No. 6219, U.S.N.M.

MASICERA POLITA, new species.

Differs from *Sturmia discalis* as follows: Palpi black, vertex one-third as wide as either eye, no orbitals, frontals descending nearly to middle of third antennal joint, the latter three times as long as the second, cheeks one-sixth the eye height, body polished, the mesonotum and narrow bases of the last three abdominal segments thinly whitish pruinose, middle tibiae bearing three bristles near the middle of the outer-anterior side, hind tibiae not ciliate, third vein of wings bearing a single bristle near the base, front pulvilli elongate; length, 5 mm. A male specimen collected August 8 by Mr. C. H. T. Townsend; received from Prof. T. D. A. Cockerell.

Habitat.—White Mountains, New Mexico (altitude about 8,000 feet).

Type.—Cat. No. 6220, U.S.N.M.

EUTHERA BICOLOR, new species.

Head yellow, occiput with a broad black streak extending from the neck to each eye and bordered below by a whitish pruinose stripe which extends downward along the orbit, sides of front and face whitish pruinose, vertex four-fifths as wide as either eye, two pairs of orbitals, frontals short and sparse, descending to base of antennae, cheeks one-sixth as wide as the eye height, antennae as long as the face, the first two joints yellow, the third black, slightly over twice as

long as the second, arista yellow at base, thickened on the basal fourth, mouth parts yellow; thorax and scutellum black, thinly whitish pruinose, the mesonotum with three broad black vittæ, two sternopleural bristles, scutellum bearing three marginal pairs, the last one very small and diverging; abdomen polished, reddish yellow, a dorsal subtriangular brownish spot extends over the first two segments, very short marginal bristles on the last three segments; coxæ and femora reddish yellow, tibiæ dark brown, tarsi black; wings from base to apex of anal cell, and from slightly beyond humeral crossvein obliquely almost to middle of discal section of fifth vein, yellow, behind fifth vein and along the apex gray, remainder brown except an oblique whitish hyaline fascia almost crossing the wing beyond the hind crossvein; first posterior cell closed, its petiole less than half as long as the hind crossvein; calypteres yellow; length, 4.5 mm. A female specimen.

Habitat.—Texas.

Type.—Cat. No. 6221, U.S.N.M.¹

MUSCOPTERYX TIBIALIS, new species.

Black, the palpi, tibiæ, and second antennal joint of female yellow, cheeks and lower part of face reddish brown; vertex of male one-third, in the female as wide as either eye, sides of face bearing three or four irregular rows of rather long bristly hairs of nearly an equal length, thorax subopaque, gray pruinose and with four black vittæ, scutellum bearing three marginal pairs of bristles, the last one cruciate, only slightly shorter than the first; abdomen somewhat polished, light grayish pruinose and with reflecting darker spots; wings hyaline, tinged with brownish toward the base, third vein bearing two bristles near the base, bend of fourth vein angular and with a short stump of a vein, the vein strongly bent inward beyond the bend; calypteres whitish; length, 7 to 9 mm. A specimen of each sex collected April 23, 1898, by Prof. J. M. Aldrich.

Habitat.—Moscow and Julietta, Idaho.

Type.—Cat. No. 6223, U.S.N.M.

¹ *Chetolyga nigrifacies* Bigot. Dr. F. Brauer has examined the type of this species and reports that it belongs to the genus *Pelmatomyia* or *Parexorista*. The species referred to it in my Revision of the Tachinidae, page 125, will therefore require a new name, for which *antennalis* is proposed; the specimen is a female, black, the sides of the second abdominal segment, hind angles of the first and front angles of the third yellow, antennæ as long as the face, the third joint over three times as long as the second, front tarsi noticeably dilated, third vein bearing a single bristle near the base.

Type.—Cat. No. 6222, U.S.N.M.

MUSCOPTERYX OBSCURA, new species.

Differs from the male of *tibialis* as follows: Tibiæ, cheeks, and face black; vertex one-fourth as wide as either eye, bristly hairs on sides of face very short, mesonotum somewhat polished, not pruinose; abdomen thinly brownish pruinose, without reflecting darker spots; third vein bearing about four bristles near the base, bend of fourth rounded, without a stump, the vein almost straight beyond the bend; calypteres yellow; length, 7 mm. Two males collected July 30 and August 24, 1897, by Prof. Trevor Kincaid.

Habitat.—St. Paul Island, Alaska.

Type.—Cat. No. 6224, U.S.N.M.

PHORICHÆTA CINEROSA, new species.

Black, the third antennal joint at base yellow. palpi at apex yellow, changing to brown at the base; sides of front, face and cheeks opaque, grayish pruinose, antennæ three-fourths as long as the face, the third joint blunt pointed at the apex, three times as long as the second; thorax and scutellum somewhat polished, rather thinly gray pruinose; abdomen highly polished, the second and third segments bearing discal and marginal bristles; wings hyaline, third vein bristly nearly to apex of discal cell; length, 4 mm. One specimen collected July 5 by Mr. H. S. Barber.

Habitat.—Flagstaff, Arizona.

Type.—Cat. No. 6225, U.S.N.M.

BRACHYCOMA PUBICORNIS, new species.

Black, including the palpi; vertex nearly half as wide as either eye, frontal bristles in a single row each side, descending slightly below base of second antennal joint, sides of face bearing a row of rather long bristles on the lower half, on the upper half with one or two irregular rows of very short bristly hairs, antennæ three-fourths as long as the face, the third joint nearly twice as long as the second, arista brown, the middle yellowish, distinctly pubescent, the longest slightly longer than greatest diameter of arista, the latter thickened almost to the middle, vibrissæ slightly above front edge of oral margin, ridges bristly on lowest third, proboscis rather short and robust; thorax grayish pruinose and with three black vittæ, scutellum bearing three pairs of marginal bristles, the last one cruciate and but slightly shorter than the others; abdomen grayish pruinose and with darker reflecting spots, first two segments without dorsal bristles, the last two with marginal ones, second segment of hypopygium polished; hind tibiæ not ciliate; wings hyaline, brownish at base and along most of the veins, third vein bristly nearly halfway to small crossvein, bend of fourth rectangular and with a short stump, costal spine minute;

calypteres whitish; length, 11 mm. A male specimen collected by Prof. J. M. Aldrich.

Habitat.—Harrison, Idaho.

Type.—Cat. No. 6226, U.S.N.M.

BRACHYCOMA SETOSA, new species.

Differs from *pubicornis* as follows: Vertex two-thirds as wide as either eye, sides of face bearing two irregular rows of rather short bristles of nearly an equal length, antennæ four-fifths as long as the face, arista bare, proboscis somewhat elongate, rigid, slender, labella very narrow, abdomen with a pair of marginal bristles on the second segment, second segment of hypopygium somewhat opaque, thinly pruinose, wings not brownish along the veins, costal spine nearly as long as the small crossvein; length, 8.5 mm. A male specimen collected July 24 by Prof. T. D. A. Cockerell.

Habitat.—Beulah, New Mexico.

Type.—Cat. No. 6227, U.S.N.M.

GÆDIOPSIS COCKERELLII, new species.

Black, the face, cheeks, and apices of palpi yellow, scutellum reddish brown; vertex one and one-fourth times as wide as either eye, sides of front thinly grayish pruinose, frontal bristles descending to the arista, an irregular row of bristles outside of them, sides of face on outer half covered with short bristly hairs, the inner half with a row of bristles, sides of face and cheeks densely pale yellowish pruinose, vibrissæ at a short distance above the oral margin, ridges bristly on the lower three-fourths, antennæ four-fifths as long as the face, the third joint two and one-half times as long as the second, arista thickened on the basal two-thirds, cheeks nearly half as wide as the eye height; thorax thinly gray pruinose and marked with four black vittæ; abdomen short and broad, somewhat opaque, not pruinose except on under side of the fourth segment, dorsum densely covered with rather long and nearly erect bristly hairs, the first three segments bearing marginal bristles; hind tibiæ evenly ciliate on the outer-anterior side and with a much longer bristle in the middle; wings hyaline, the base brown, small crossvein clouded with brown, third vein bearing two bristles near the base, calypteres brown; length, 11 mm. A male specimen collected August 20 by Mr. C. H. T. Townsend, and received from Prof. T. D. A. Cockerell, for whom this fine species is named.

Habitat.—White Mountains, New Mexico (altitude about 8,200 feet).

Type.—Cat. No. 6228, U.S.N.M.

GÆDIOPSIS FACIALIS, new species.

Black, the second antennal joint, palpi, apex of scutellum, a spot on sides of second and the fourth abdominal segment yellow; vertex as

wide as either eye, a row of stout bristles outside of the frontals, ocellars present, large, sides of front yellowish gray, the face and cheeks whitish pruinose, sides of face bearing several short bristly hairs on the lower portion, antennæ nearly as long as the face, the third joint almost six times as long as the second; thorax gray pruinose, marked with four black vittæ, apical pair of scutellar bristles nearly horizontal, abdomen grayish pruinose and with darker reflecting spots, second and third segments bearing marginal bristles; hind tibiæ on the outer-anterior side evenly ciliate with short bristles and with a much longer one at the middle; wings hyaline, third vein bearing two bristles near the base, calypteres white; length, 9 mm. A male specimen collected by Mr. H. K. Morrison.

Habitat.—Georgia.

Type.—Cat. No. 6230, U.S.N.M.

GÆDIOPSIS OCELLARIS, new species.

Differs from *facialis* as follows: Antennæ and abdomen black, lower portion of sides of front, the face and fourth abdominal segment densely golden yellow pruinose; sides of face bearing two irregular rows of bristles, ocellar bristles wanting, a pair of marginal bristles on the first abdominal segment; length, 9 mm. A male specimen collected June 18, 1891, by Prof. James S. Hine.

Habitat.—Ohio.

Type.—Cat. No. 6229, U.S.N.M.

PARAPHYTO SARCOPHAGINA, new species.

Black, the antennæ, face, and cheeks reddish brown, palpi yellow; vertex one-fourth as wide as either eye, sides of face bearing a few short bristly hairs on the upper edge, antennæ half as long as the face, the third joint scarcely longer than the second, longest hairs of arista slightly longer than greatest diameter of arista, vibrissæ a short distance above oral margin, cheeks nearly half as wide as the eye height, head at vibrissæ slightly shorter than at base of antennæ, proboscis slender, labella unusually slender; thorax gray pruinose and marked with three black vittæ, three pairs of postsutural dorso-central bristles, two sternopleurals, scutellum bearing three marginal pairs, the third pair cruciate; abdomen grayish pruinose and with darker reflecting spots, hairs depressed, second and third segments with marginal bristles, the fourth with a submarginal row of large bristles and a marginal row of small ones; claws and pulvilli very long; wings hyaline, tinged with yellowish toward the base, third vein bearing three bristles near the base, calypteres whitish; length, 10 mm. A male specimen collected by Mr. Charles Robertson.

Habitat.—Carlinville, Illinois.

Type.—Cat. No. 6231, U.S.N.M.

MERIANIA CHALYBÆA, new species.

Head black, facial depression yellowish, bordered each side by reddish brown which, below the middle, is prolonged to the lower end of the eye, frontal vitta of male almost obliterated for a short distance, vertex of female one and one-fourth times as wide as either eye, female with the ocellar bristles present and three pairs of orbitals, wanting in the male, frontals descending nearly to middle of second antennal joint, sides of face covered on the triangular upper outer half with rather long, black bristly hairs, vibrissæ far above the oral margin, ridges bristly on the lowest fourth; antennæ orange yellow, scarcely reaching below middle of face, the third joint only slightly longer than the second, arista brown, thickened on the basal third, the penultimate joint shorter than broad; proboscis black, palpi yellow; thorax blackish steel blue, thinly whitish pruinose, and marked with four black vittæ, four pairs of postsutural dorsocentral bristles, three sternoplurals; scutellum reddish yellow, bearing five marginal pairs of bristles, the last pair the shortest, cruciate; abdomen steel blue, polished, very thinly whitish pruinose, last three segments with discal and marginal bristles; legs black, hind tibiæ not ciliate, front pulvilli of male longer than last tarsal joint, last four joints of front tarsi of female greatly dilated; wings hyaline, third vein bearing three small bristles near the base, calypteres whitish, bordered with brown; length, 8 to 11 mm. Two males and five females, collected by Prof. J. M. Aldrich.

Habitat.—Moscow, Vollmer (May 30), Julietta, Grangeville, and Craig Mountains, Idaho.

Type.—Cat. No. 6232, U.S.N.M.

This European genus has not heretofore been recorded from this country. In the table of genera given in my Revision of the Tachinidæ it would belong to couplet 43, and will be recognized by the absence of ocellar bristles in the male and the greatly dilated front tarsi of the female; the first posterior cell ends far before the wingtip.

AMOBIA AURATA, new species.

Black, including the palpi; sides of front, of face, and the cheeks golden yellow pruinose; sides of face bearing two rows of rather short bristly hairs; thorax gray pruinose, marked with three black vittæ, a black streak on pleura in front of wing; abdomen on first three segments bluish gray pruinose, the hind margin of each and three triangular spots extending from it across the segment, black; fourth segment and remainder of abdomen posterior to it golden yellow pruinose, the former crossed longitudinally with three brownish spots; wings hyaline, third vein bearing two bristles near the base, calypteres white; length, 7 mm. Three female specimens.

Habitat.—White Mountains, New Hampshire (H. K. Morrison); Milwaukee, Wisconsin (Dr. S. Graenicker); and Harrison, Idaho (J. M. Aldrich).

Type.—Cat. No. 6233, U.S.N.M.¹

GYMNOMMA QUADRISSETOSA, new species.

Head yellow, upper part of occiput and sides of front black, yellowish gray pruinose, hairs of face and cheeks yellowish white, antennæ yellow, the third joint yellowish brown, slightly longer than the second, strongly convex on the upper side, proboscis black; thorax black, densely yellowish gray pruinose and with four black vittæ, four pairs of postsutural dorsocentral bristles, three sternopleurals, scutellum yellowish brown, abdomen black, polished, second segment with a marginal pair of bristles, the third with a marginal row, the fourth covered except on the basal third, on either side of the first and second segments are two or three stout bristles; legs black; wings grayish, the base tinged with yellow, base of third vein bearing six bristles, calypteres yellowish smoky brown; length, 12 mm. Five females collected July 15 by Mr. C. H. T. Townsend.

Habitat.—Sierra Madre, Mexico (altitude about 7,300 feet).

Type.—Cat. No. 6260, U.S.N.M.²

¹*Fabricia infumata* Bigot. The type of this species has been examined by Dr. F. Brauer, who reports that it belongs to the genus *Parafabricia*. The form described under this name in my Revision of the Tachinidæ, page 144, will therefore require a new name, for which *palpalis* is proposed. The third antennal joint is nearly ellipsoidal in outline, nearly twice as long as wide, as long as the second, arista thickened on the basal four-fifths, the last joint less than three times as long as the preceding, sides of face on the triangular upper-outer half covered with short yellow bristly hairs, mesonotum bluish gray pruinose.

Type.—Cat. No. 6234, U.S.N.M.

Jurinia metallica Desvoidy. Dr. Brauer has also studied the type of this species, and reports that it is evidently the same as *Jurinia histricoides* Williston. The species described as *metallica*, in my Revision, page 147, may therefore take the name of *adusta*, which is there given as a synonym of the former.

²The species described in my synopsis of the Tachinidæ, page 145, as *Epalpus nigripilosus* is not that species, but will form a new genus differing from *Epalpus* by having only a median discal and marginal pair of bristles on the second abdominal segment and only a discal pair and marginal row on the third; from *Gymnomma* it differs in that the ocellar bristles are wanting; third joint of antennæ nearly twice as long as the second, strongly convex on the upper side, black, the base and remainder of antennæ yellow, arista black, its penultimate joint over twice as long as broad, palpi wanting, eyes bare, thorax black, densely yellowish gray pruinose and with four black vittæ, scutellum yellow. The genus may be named *Parépalpus*, new genus, and the species *flavida*, new species.

Family DEXIDÆ.

MYOCERA BIVITTATA, new species.

Black, the second antennal joint, face, cheeks, and palpi yellow; antennæ three-fourths as long as the face, the third joint nearly three times as long as the second, arista rather long plumose, sides of face on the upper part golden yellow pruinose, and with a few short black bristly hairs, on the lower portion and the cheeks in certain lights very thinly whitish pruinose; cheeks two-thirds as broad as the eye height; proboscis one and one-fifth times as long as height of head, slender, rigid, labella small; body rather slender, gray pruinose; mesonotum with three, scutellum with one, first three segments of abdomen with two black vittæ, the latter united on the first segment; also a black vitta on pleura in front of each wing; second and third abdominal segments bearing only marginal bristles; hind tibiæ not ciliate, middle tibiæ bearing a single bristle on the outer-anterior side, front pulvilli greatly elongated; wings hyaline, gray at the base, veins bare, bend of fourth rounded and without an appendage, front calypter and base of the other white, remainder of the hind one brown; length, 7 mm. A male specimen collected August 17 by Mr. C. H. T. Townsend; received from Prof. T. D. A. Cockerell.

Habitat.—White Mountains, New Mexico (altitude about 8,200 feet).

Type.—Cat. No. 6235, U.S.N.M.

MEGAPARIA FLAVEOLA, new species.

Yellow, the mesonotum except lateral margins, and a median vitta on the abdomen black; base of scutellum brown; vertex one-third as wide as either eye, sides of face bare, cheeks slightly less than half as wide as the eye height, antennæ nearly half as long as the face, the third joint slightly longer than the second; arista black, its longest hairs only slightly longer than its greatest diameter; proboscis and palpi unusually short and robust; mesonotum gray pruinose, marked with three black vittæ; abdomen yellowish gray pruinose, the first three segments with marginal bristles; hind tibiæ not ciliate, claws and pulvilli unusually long; wings hyaline, third vein bristly halfway to small crossvein, fourth vein rounded at the bend and without an appendage, first posterior cell closed in the wingmargin, calypteres whitish; length, 8 mm. A male specimen.

Habitat.—Colorado.

Type.—Cat. No. 6236, U.S.N.M.

CHÆTONA FLAVIPENNIS, new species.

Black, the antennæ and palpi yellow, frontal vitta, cheeks, and lower part of sides of face, reddish brown; vertex of male one-sixth, in the

female one and one-fourth times as wide as either eye, one pair of orbital bristles in the female, frontals descending nearly to middle of second antennal joint, sides of face covered with rather short bristly hairs on the upper half, antennae from two-thirds to three-fourths as long as the face, the third joint in the male nearly twice, in the female one and one-half times as long as the second, longest hairs of arista nearly three times as long as its greatest diameter, cheeks one-seventh as wide as the eye height, proboscis very short and robust, labella very large; body densely yellowish gray pruinose, mesonotum with four indistinct darker vittae, three pairs of postsutural dorsocentrals, two sternopleurals, hairs of middle of dorsum of abdomen depressed, first segment without dorsal bristles, the following two with a marginal row of rather short ones; hind tibiae not ciliate, pulvilli of male elongate; wings and veins yellowish, third vein bearing two bristles near the base, fourth vein broadly arcuate at the bend, ending just above the wingtip, hind crossvein nearly midway between the small and bend of fourth; calypteres yellow; length, 9 mm. A specimen of each sex collected May 6, 1900, by Prof. James S. Hine.

Habitat.—Vinton, Ohio.

Type.—Cat. No. 6237, U.S.N.M.

Family ANTHOMYIDÆ.

PHAONIA PALLIDULA, new species.

Male.—Head black, face and frontal orbits whitish pruinose, eyes as widely separated as the posterior ocelli, frontal vitta obliterated for a short distance, antennae three-fourths as long as the face, dark brown, the first two joints and base of the third yellow, third joint nearly twice as long as the second, longest hairs of arista three times as long as greatest diameter of arista, hairs of eyes rather sparse, cheeks about one-fifth as broad as the eye-height, proboscis dark brown, slender and rigid, labella small and very narrow, palpi yellow, narrow; thorax black, bluish gray pruinose, marked with four indistinct blackish vittae, three pairs of postsutural dorsocentral bristles, one or two pairs of acrostichals, none in front of the suture; sternopleurals one and two; scutellum yellow, grayish pruinose, base of upper side broadly blackish; abdomen yellowish, varied with pale brownish, the last two segments largely of this color, wholly gray pruinose, viewed from behind discloses an interrupted blackish dorsal vitta, last two segments bearing a discal and a marginal row of bristles; venter yellow, an interrupted black vitta in the middle; legs yellow, front femora largely black, an interrupted pale brown band toward apices of the other femora, tarsi brown; middle femora bearing a row of rather long bristles on basal two-thirds of under side, the hind ones with two rows of rather long ones extending nearly whole length of

under side; front tibiae bearing a bristle near middle of posterior side, middle tibiae with one above and one below the middle of the posterior side, hind tibiae with two near middle of inner-anterior, two near middle of outer-anterior, and one below middle of outer-posterior side; front pulvilli as long as the last tarsal joint; wings hyaline, costal spine minute, fourth vein diverging from the third; calypteres white, halteres yellow; length 7 mm. A male specimen collected by Mr. H. K. Morrison.

Habitat.—Southern Georgia.

Type.—Cat. No. 6238, U.S.N.M.

MYDÆA FLAVICORNIS, new species.

Head black, frontal orbits and face whitish pruinose, eyes of male almost contiguous, the frontal vitta obliterated for a short distance; antennae yellow, arista at base yellow, the remainder brown, the longest hairs about twice as long as greatest diameter of arista, antennae slightly shorter than the face, the third joint broad, nearly three times as long as the second; cheeks about one-tenth as wide as height of eyes, proboscis dark brown, short and robust, palpi slender, yellow; thorax black, gray pruinose, and marked with four black vittae, four pairs of postsutural dorsocentral bristles, sternopleurals one and two; one pair of acrostichal bristles, hairs between dorsocentral bristles arranged in about eight irregular rows; scutellum yellow, the base usually brown, three pairs of marginal bristles, of which the basal pair is about half as long as the others; abdomen black, gray pruinose, the last two segments bearing discal and marginal bristles; femora, tibiae, and tarsi yellow, bristles on under side of middle and hind femora, except on apical third of the latter, shorter than diameter of the femora; front tibiae without bristles except at apex, middle tibiae each bearing two near middle and three-fourths of the posterior side, hind ones bearing two below middle of anterior-inner and two near middle of anterior-outer side; wings hyaline, veins yellow, bare, fourth vein diverging from the third, hind crossvein nearly straight, small crossvein near two-thirds length of discal cell, costal spine wanting; calypteres yellowish white; length, nearly 5 mm. Two males and one female.

Habitat.—Rouville County, Quebec, Canada (May 24, 1900, Mr. G. Chagnon), and St. Louis, Missouri.

Type.—Cat. No. 6239, U.S.N.M.

CHIROSIA CAPITO, new species.

Male.—Black, the lower part of the front, extending along sides of facial ridges nearly to their lower ends, the halteres and bases of tibiae yellow; face and frontal orbits whitish pruinose, front at nar-

rowest point nearly as wide as either eye, frontal orbits unusually wide, wider than frontal vitta at base, the latter strongly contracted above, at its narrowest point about as wide as lowest ocellus, head considerably inflated, three pairs of frontal bristles, proboscis rather slender, rigid, with small labella; antennæ three-fourths as long as the face, the second joint three-fourths as long as the third, arista almost bare, thickened on the basal fourth; body densely light bluish gray pruinose, unmarked; three pairs of postsutural dorsocentral bristles, sternopleurals one and two, scutellum bearing a subbasal and a subapical pair; abdomen depressed, narrow, hypopygium rather small, with a fissure slightly to left of median line, no ventral lobes; middle femora bristly on basal half of under side, the hind ones on nearly their entire length; front tibiae bearing a bristle near two-thirds length of outer side and another below middle of inner-posterior side; middle tibiae with one below middle of outer-anterior, one on outer-posterior, and two on median third of inner-posterior side; hind tibiae ciliate, with rather short bristles on nearly the entire length of the inner-anterior and inner-posterior sides, and with about five larger bristles on the outer-anterior and outer-posterior sides; front pulvilli as long as the last tarsal joint; wings whitish hyaline, costa not distinctly spinose, costal spine about as long as the small crossvein.

Female.—Differs from the male as follows: Front twice as wide as either eye, frontal vitta only slightly contracted above, two pairs of orbital bristles and a cruciate pair of preocellars, second antennal joint about half as long as the third, abdomen broad at base, tapering to the tip; hind tibiae bearing only two bristles on the anterior-inner side, none on the posterior-inner, front pulvilli about half as long as the last tarsal joint, costa with rather long spines.

Length, 4.5 mm. A specimen of each sex received from Mr. C. W. Johnson.

Habitat.—Manumuskin, New Jersey.

Type.—Cat. No. 6197, U.S.N.M.

Family SCATOPHAGIDÆ.

PSELAPHEPHILA SIMILIS, new species.

Head yellow, the occiput and three triangular spots on vertex black, gray pruinose, face, except its extreme sides, white pruinose, frontal orbits whitish pruinose, changing above to gray; antennæ black, first two joints and base of third yellow, palpi light yellow, proboscis black; body black, thorax densely, the abdomen thinly bluish gray pruinose, the abdomen somewhat polished; femora black, their broad apices and the tibiae yellow, tarsi darker yellow; bristles of legs and body normal; wings grayish hyaline, the veins brown; halteres yellow; length, 4 mm. One male and seven females collected April 30, 1870; May 8, 1869,

and June 3, 1876, by Mr. Edward Burgess. Also a female specimen collected May 12, 1900, in Chambly County, Quebec, Canada, received for naming from Mr. C. W. Johnson, of Philadelphia, to whom it has been returned.

Habitat.—Beverly, Massachusetts.

Type.—Cat. No. 6240, U.S.N.M.

Family MICROPEZIDÆ.

CALOBATA VITTIPENNIS, new species.

Head reddish brown, whitish pruinose, lower part of front black and somewhat polished, followed by a velvet black fascia expanded in the form of a tooth in the middle below and also above on either side of the ocelli, vertex, except the ocellar triangle, steel-blue, polished; one pair of postvertical bristles, two widely separated pairs of vertical and one pair of orbital bristles; antennæ reddish brown, the third joint twice as long as wide, arista bare; clypeus and palpi reddish brown, proboscis dark brown; body bluish black, grayish pruinose, the humeri, propleura, and hypopygium reddish brown, two or three bristles in front of each middle coxa; legs dark brown, extreme bases of middle femora and two bands on their apical half yellowish, hind femora yellow, a broad median band and a narrower one midway between it and the apex brown, front tarsi except base of first joint whitish, changing to yellow toward the apex; wings grayish hyaline, slightly tinged with yellow along the costa, first posterior cell brown, this color encroaching on the submarginal cell at its apex and on the middle and upper part of the apical half of the discal cell; apex of first vein far before the small crossvein, last section of fourth vein one and one-fifth times as long as distance between apices of second and third veins, anal cell prolonged over halfway from the fifth vein to the wing margin; length, 6 to 9 mm. Four males and three females collected April 27 to 29 by Mr. C. H. T. Townsend.

Habitat.—Frontera, Mexico.

Type.—Cat. No. 6261, U.S.N.M.

Family TRYPETIDÆ.

SPILOGRAPHA FRACTURA, new species.

Yellow, an ocellar dot and band beyond middle of hypopygium black; face strongly retreating below, mesonotum subopaque, thinly gray pruinose, bristles of thorax and the four on scutellum black, short hairs of mesonotum chiefly black, abdomen polished, its hairs black; wings hyaline, a black spot fills stigma and crosses marginal cell, a black band begins at first vein above forking of the second and third and extends to apex of anal cell; a black cloud on small and

another on posterior crossvein, a brown dot below middle of penultimate section of fifth vein, a black spot midway between apices of first and second veins extending from costa to middle of submarginal cell, apex of wing from before apex of second vein to beyond apex of fourth broadly bordered with black, the inner edge of this border concave; small crossvein near two-thirds length of discal cell and noticeably beyond apex of first vein, third vein bristly nearly its entire length; length, 4 to 5 mm. Five males and three females.

Habitat.—White Mountains, New Mexico (8,000 feet elevation, Townsend), and Colorado (Morrison).

Type.—Cat. No. 6262, U.S.N.M.

LIST OF BIRDS COLLECTED BY WILLIAM T. FOSTER IN PARAGUAY.

By HARRY C. OBERHOLSER.

Assistant Ornithologist, Department of Agriculture.

The collection of Paraguay birds sent by Mr. William T. Foster to the United States National Museum, though small, is of more than casual interest. It consists of 78 specimens, representing 65 species and subspecies, several of which appear to be heretofore unrecorded from Paraguay; while *Blacicus pileatus*, *Myiopagis caniceps*, *Phylloscopus salvadorii*, and *Cyanocorax heckelii* are of sufficient rarity to be worthy of special mention. Further than this, there are seven birds (four species and three subspecies) that seem to be new to science; and of these preliminary descriptions have already been published.¹ Matter between quotation marks in the following list is from the notes of the collector.

Sapucay, Paraguay, whence come these specimens, is situated a short distance east of the city of Asuncion, thus somewhat south of the central portion of the country.

The subjoined notes are presented at the instance of Mr. Ridgway, curator of the division of birds, to whom and to Dr. Charles W. Richmond the writer is indebted for many kindnesses. To the authorities of the American Museum of Natural History, for the loan of specimens, due acknowledgment should here be made.

Family BUCCONIDÆ.

BUCCO CHACURU Vieillot.

Bucco chacuru VIEILLLOT, Nouv. Dict. d'Hist. Nat., III, 1816, p. 239.

One adult female. "Iris brownish white." In this species there seems to be much individual difference in the depth of the buffy tinge on the lower surface and on the collar; in some specimens these parts are almost pure white, in others deep ochraceous.

¹Proc. Biol. Soc. Wash., XIV, 1901, p. 187.

Family PICIDÆ.

VENILIORNIS SPILOGASTER (Wagler).

Picus spilogaster WAGLER, Syst. Avium, 1827, Picus, sp. 59, p. 33.

Veniliornis spilogaster OBERHOLSER, Proc. Acad. Nat. Sci. Phila., 1899, p. 205.

One adult female, seemingly identical with a specimen taken at Buenos Ayres. "Iris brownish red."

PICUMNUS CIRRATUS Temminck.

Picumnus cirratus TEMMINCK, Pl. Col., IV, 1825, pl. CCCLXXI, fig. 1.

One specimen, apparently immature, and differing from the adult in the duller shade of back and scapulars. "Iris brown."

Family FORMICARIIDÆ.

HERPSILOCHMUS RUFIMARGINATUS (Temminck).

Myiothera rufimarginata TEMMINCK, Pl. Col., II, 1822, pl. CXXXII, figs. 1, 2.

Herpsilochmus rufimarginatus CABANIS, Wiegmann's Archiv f. Naturg., 1847, Pt. 1, p. 224.

One adult male, June 27, 1900. "Iris brown." The back of this specimen has considerable admixture of black. Temminck's original description of *Myiothera rufimarginata*,¹ and Maximilian's *Myiothera scapularis*² represent a bird without black on the back; while *Myiothera variegata* Maximilian³ is said to differ in having black on some of the dorsal feathers. Unless this be a difference due to age or individual variation—apparently an unlikely hypothesis—there are probably two species now confused under the name *Herpsilochmus rufimarginatus*, one of which should stand as *Herpsilochmus variegatus* (Maximilian). Sufficient material to settle the question we have not available.

DYSITHAMNUS MENTALIS (Temminck).

Myiothera mentalis TEMMINCK, Pl. Col., II, 1823, pl. CLXXXIX, fig. 3.

Dysithamnus mentalis BURMEISTER, Syst. Ueber. Vög. Bras., III, 1857, p. 82.

One adult male, in perfect plumage and entirely typical. "Iris brown."

In a comparatively recent paper Dr. Allen⁴ has united under this species both *Thamnophilus olivaceus* Tschudi⁵ and *Dysithamnus semicinctus* Selater,⁶ following to ultimate end the doubt expressed by Dr. Selater regarding the distinctness of the last.⁷ True *Dysithamnus*

¹Pl. Col., II, 1822, pl. CXXXII, figs. 1, 2.

²Beitr. Naturg. Bras., III, 1830, p. 1083.

³Idem, p. 1086 (Lichtenstein manuscript).

⁴Bull. Amer. Mus. Nat. Hist., V, 1893, p. 118.

⁵Faun. Per., Aves, 1845-46, p. 174, pl. xi, fig. 1.

⁶Proc. Zool. Soc. Lond., 1855, pp. 90, 147, pl. xcvi.

⁷Cat. Birds. Brit. Mus., XV, 1890, p. 221.

mentalis, according to Temminck's original plate and description, with which the above mentioned Paraguay specimen perfectly agrees, is uniform dull grayish olive green on all the middle and posterior upper parts, this color being trenchantly defined against the plumbeous of head and cervix; the throat is grayish white, giving way rather abruptly to the clear naples yellow of breast and abdomen. But *Dysithamnus olivaceus* is apparently quite a distinct species, the male differing from that of *D. mentalis* in being usually quite uniform plumbeous above, and though sometimes appreciably tinged with olive, principally on the rump, never olive green; the lower surface posterior to the throat is never clear yellow, but generally white medially, much shaded with slate gray laterally, and on flanks and crissum tinged with pale brownish, ochraceous, or yellowish. The same large series which Dr. Allen studied has been examined in the present connection; and a considerable number of additional specimens in the United States National Museum, principally from Colombia and Central America, have thrown light upon the questions involved. Two forms of *D. olivaceus* are readily recognizable, *D. olivaceus olivaceus* from Peru, Bolivia and western Brazil, and *D. olivaceus semicinereus* from Colombia and Central America. While it is true that there are absolutely no valid characters by which the males of these two forms can be separated, there is no difficulty at all in distinguishing the *females*, for those of *semicinereus* are very much darker both above and below, specimens from Colombia (Bogota) being extreme in this particular.

With regard to the proper names for these two forms there is, unfortunately, some room for question. The point to be determined is the identity of Tschudi's name *olivaceus*, which from plate and description might apply to either the Brazilian or Central American bird. The present separation of *olivaceus* and *semicinereus* is based on comparison of specimens from Matto Grosso, Brazil, which are considered to represent *olivaceus*, with examples from Bogota, the type locality of *semicinereus*; while none from Ecuador, Peru, or Bolivia have been available. Should Peruvian specimens prove *olivaceus* identical with *semicinereus*, the latter would, of course, become a synonym, and another subspecific name would be necessary for the bird of western Brazil, which undoubtedly would be *affinis* Pelzeln.¹ Although strongly inclined to the belief that this will some day have to be done, we refrain from making such a change until absolute proof of the necessity be obtained.

THAMNOPHILUS CÆRULESCENS Vieillot.

Thamnophilus caeruleescens VIEILLOT, Nouv. Dict. d'Hist. Nat., III, 1816, p. 311.

A single adult male in perfect plumage is apparently typical. "Iris brown."

¹ Orn. Bras., 1869, pp. 80, 149.

THAMNOPHILUS OCHRUS Oberholser.

Thamnophilus ochrus OBERHOLSER, Proc. Biol. Soc. Washington, XIV, 1901, p. 188.

Chars. sp.—Female resembling that of *Thamnophilus cærulescens*, but rather lighter, more grayish above; the lesser wing-coverts black instead of olivaceous; the entire ventral surface decidedly paler, the breast grayish buff, the central portion of abdomen buffy white.

Description.—Type, adult female, No. 173378, U.S.N.M.; Sapucay, Paraguay, June 24, 1900; William T. Foster. Upper parts grayish olive brown, more brownish on the scapulars and on the crown, the fore part of which latter is lighter; the feathers of the center of the back with large ill-concealed white spots usually in the form of broad irregular bars, succeeded distally by a more or less evident subterminal mark of blackish; middle tail-feathers similar to the general tone of the back, though rather darker, unmarked with white, the remaining rectrices brownish black, margined with brownish slate, and tipped with white, the outer pair with also a white bar about 7 millimeters wide near the middle of the external web; wing-quills fuscous, edged exteriorly with olive brown; all the superior coverts black tipped with white, the greater series margined basally with grayish olive brown; lores, cheeks, and eye ring grayish white, much mixed with grayish olive; sides of neck and head behind the eyes grayish olive, the auriculars rather darker with shaft lines of buffy white; chin and throat grayish white mixed with dusky and very faintly washed with ochraceous; breast grayish buff—or better, dull pale gray washed with ochraceous buff; sides, flanks, and crissum plain ochraceous, the center of abdomen and lower breast dull buffy white; under wing-coverts and inner margins of wing-quills buffy white; axillars buffy ochraceous. Bill brownish black, the base of mandible paler; "iris brown." Length of wing, 70 mm.; tail, 65 mm.; exposed culmen, 12 mm.; height of bill at base, 5.5 mm.; tarsus, 23.5 mm., middle toe, 13 mm.

Only a single specimen, the female above described, was obtained by Mr. Foster, but this apparently differs so greatly and in so many respects from the same sex of all allied species that it seems undoubtedly to represent a form hitherto undescribed. It seems to be nearest *Thamnophilus cærulescens* in size and proportions, and in these respects scarcely exhibits material difference, though in color it is of quite other appearance, as above set forth. The only other species with which it seems to have at all close affinity is *Thamnophilus aspersiventer* d'Orbigny and Lafresnaye,¹ from Yungas, Bolivia, but judging from the various descriptions of this latter, the female of *Thamnophilus ochrus* is very much paler below, having a broad buffy white area on

¹Synopsis Avium, I, 1837, p. 10; d' Orbigny, Voyage Amer. Mérid., IV, Ois., 1835-44, p. 171, pl. iv, figs. 1 and 2.

the lower breast and in the center of the abdomen, sharply contrasted to the ochraceous of sides and flanks; also the bill of *ochrus* is of smaller size.

There are apparently no synonyms that apply to this new species, for *Thamnophilus pileatus* Swainson¹ is clearly not the same, if indeed at all with certainty identifiable; and *Thamnophilus ventralis* Selater² is undoubtedly the *Thamnophilus cerulescens* of Vieillot. Furthermore the *Thamnophilus auratus* of Vieillot³ does not correspond with the bird sent by Mr. Foster, and quite surely is the female of *T. cerulescens*.

THAMNOPHILUS RADIATUS Vieillot.

Thamnophilus radiatus VIEILLOT, Nouv. Dict. d'Hist. Nat., III, 1816, p. 315.

The single adult female is apparently typical of this species. "Iris buff."

HYPOEDALEUS GUTTATUS (Vieillot).

Thamnophilus guttatus VIEILLOT, Nouv. Dict. d'Hist. Nat., III, 1816, p. 315.

Hypodaleus guttatus CABANIS and HEINE, Mus. Hein., II, 1859, p. 18.

One adult male, seemingly indistinguishable from a specimen taken in Rio Grande do Sul, Brazil. "Iris brown."

This species differs so greatly in the shape of the bill and length of tail from the typical forms of *Thamnophilus* that there seems to be excellent reason for the generic separation proposed by Cabanis and Heine,⁴ and here adopted.

Family DENDROCOLAPTIDÆ.

PICOLAPTES TENUIROSTRIS APOTHETUS Oberholser.

Picolaptes tenuirostris apothetus OBERHOLSER, Proc. Biol. Soc. Washington, XIV, 1901, p. 188.

Chars. subsp.—Similar to *Picolaptes tenuirostris tenuirostris*, but very much smaller, and with the pale shaft streaks of the back decidedly more narrow.

Description.—Type, adult male, No. 173385, U.S.N.M.; Sapucay, Paraguay, June 16, 1900; William T. Foster. Upper parts olive brown, the back more reddish, the rump and upper tail-coverts chestnut; head thickly spotted with ochraceous, which markings become broad shaft-streaks on the cervix and dwindle to narrow shaft lines on the interscapulum; tail chestnut; wings fuscous, when closed the exposed surface reddish olive brown, excepting the innermost secondaries which are entirely dark chestnut, and the inner margins

¹Zoological Journal, II, 1825, p. 91.

²Edinb. New. Philos. Journ., New Ser., I, 1855, p. 244.

³Nouv. Dict. d'Hist. Nat., III, 1816, p. 312.

⁴Mus. Hein., II, 1859, p. 18.

of the basal portions of the quills, which are fulvous; lores, cheeks, and superciliary stripe pale buff, the first mixed, the rest finely squamate with olive brown; auriculars ochraceous buff, on lower half mixed with olive brown, on upper portion dark brown mixed with buffy; sides of neck ochraceous, with squamate markings of dark olive brown; chin and throat deep buff, unmarked; rest of inferior surface dull grayish olive brown, much paler than the upper parts, and broadly streaked, particularly on median portion, with dull ochraceous buff, the crissum rather more rufescent; lining of wing ochraceous buff. "Iris brown."

The difference in size exhibited by the single specimen above described is so great that it seems not to be attributable to sex or age, but to indicate a geographical race worthy of recognition. The character of the dorsal markings is constant in the six Brazilian specimens examined. Both of the synonyms of *Picolaptes tenuirostris*—*Dendrocolopus fuscus* Vieillot,¹ and *Picolaptes guttata* Lesson,² refer without doubt to the bird from Brazil, so that the Paraguay form is without a name.

The size of both *tenuirostris* and *apothetus* is shown in the following table of millimeter measurements:

Name.	Sex.	Locality.	Wing.	Tail.	Exposed culmen.	Tarsus.
<i>Picolaptes tenuirostris tenuirostris</i>	Male	Brazil	79	69	23	20
Do	Male?	do	88	71	25	19
Do	Male?	Bahia, Brazil	84	69	27	18
Average	83.7	69.7	25	19
<i>Picolaptes tenuirostris apothetus</i>	Male	Sapucay, Paraguay.	74	65	22	18

Family FURNARIIDÆ.

SITTASOMUS ERITHACUS (Lichtenstein).

Dendrocolaptes erithacus LICHTENSTEIN, Abhandl. Akad. Berl., 1820, p. 259, pl. 1.
Sittasomus erythacus BONAPARTE, Consp. Avium, I, 1850, p. 209.

The single example differs from one taken at Bahia, Brazil, in its deeper, more yellowish olive color both above and below. "Iris brown."

XENICOPSIS ACRITUS (Oberholser).

Anabazenops acritus OBERHOLSER, Proc. Biol. Soc. Washington, XIV, 1901, p. 187.
Xenicopsis acritus OBERHOLSER, Proc. U. S. Nat. Mus., XXV, 1902, p. 61.

Chars. sp.—Similar to *Xenicopsis oleagineus* (Selater), but decidedly darker, particularly below, the color throughout greenish olive instead of olive brown, the superciliary stripe deeper ochraceous, the throat more yellowish, the light areas of the lower surface more greenish.

¹ Nouv. Dict. d'Hist. Nat., XXVI, 1818, p. 117.

² Cent. Zool., 1830, p. 93, pl. xxxii.

Description.—Type, adult male, No. 173384, U.S.N.M.: Sapucay, Paraguay, June 14, 1900; William T. Foster. Upper surface almost uniform dull, dark olive green, many of the feathers with very narrow dusky margins producing a slight squamate effect; tail bright chestnut, unmarked; wings dark brown, the innermost secondaries, outer vanes of primaries and exposed surface of all the superior wing-coverts rufescent olive brown, the inner margins of all the quills deep ochraceous; lores and superciliary stripe rich ochraceous, the former mixed with olive, the latter somewhat paler posteriorly; sides of head and neck dull olive green, much streaked with yellowish and buffy white; chin and upper throat pale maple yellow, the feathers with small terminal spots of olive; rest of lower surface dull olive green, streaked with yellowish white, greenish white, and pale ochraceous, most broadly along the median line, most narrowly on flanks and sides where restricted to fine shaft lines, all this streaking distinct, as in *Xenicopsis oleagineus*; erissum with a rufous tinge; lining of wing dark ochraceous. "Iris brown." Length of wing, 75 mm.; tail, 76 mm.; exposed culmen, 16 mm.; tarsus, 23 mm.; middle toe, 17 mm.

This new species, of which but a single specimen is in the collection, is apparently most closely allied to *Xenicopsis oleagineus* (Sclater),¹ but compared with some of the original specimens of that species it differs as above stated. With *X. rufosuperciliatus* (Lafresnaye)² it can scarcely be confused, being so very different in its dull olive green instead of rufescent olive brown, both above and below, and in the very much more sharply defined markings of the ventral surface. Reichenbach's *Cichlocolaptes ochrolepharus*³ and his *Cichlocolaptes adpersus*⁴ belong undoubtedly under *Xenicopsis rufosuperciliatus*, so that the present bird appears never to have been described.

The type of the genus *Anabazenops* is clearly *Sitta fusca* Vieillot (= *Anabatoides fuscus* Auct.) for which this name should be used, leaving, as Dr. Sharpe has indicated,⁵ *Xenicopsis* Cabanis and Heine for the group commonly known as *Anabazenops*.

PHILYDOR RUFUS (Vieillot).

Dendrocopus rufus VIEILLOT, Nouv. Dict. d'Hist. Nat., XXVI, 1818, p. 119.

Philydor rufus CABANIS and HEINE, Mus. Hein., II, 1859, p. 29.

One specimen, apparently identical with a Brazilian example. "Iris brown."

¹Proc. Zool. Soc. Lond., 1883, p. 654.

²Mag. de Zool., 1832, Ois., pl. vii.

³Handbuch der Spec. Orn., 1851, p. 174, pl. DXXVII, fig. 3638.

⁴Idem, p. 174.

⁵Hand-List Gen. and Spec. Birds, III, 1901, p. 70.

ANUMBIUS ANNUMBI (Vieillot).

Furnarius annumbi VIEILLOT, NOUV. DICT. D'HIST. NAT., XII, 1817, p. 117.

Anthus acuticaudatus LESSON, TRAITÉ D'ORN., 1831, p. 424.

The one adult male in the collection seems to be just like specimens from Buenos Ayres. "Iris brown."

This well-known species, the *Anumbius acuticaudatus* of authors, should be called *Anumbius annumbi*, as above given, since this name is by several years the older, as well as of undoubted application.

SYNALLAXIS SPIXI Sclater.

Synallaxis spixi SCLATER, PROC. ZOOL. SOC. LOND., 1856, p. 98.

The single example, an adult male, is apparently indistinguishable from the birds of Brazil which represent the typical form of the species. "Iris brown."

SYNALLAXIS RUFICAPILLA Vieillot.

Synallaxis ruficapilla VIEILLOT, NOUV. DICT. D'HIST. NAT., XXXII, 1819, p. 310.

One specimen, an adult female. "Iris brown."

LOCHMIAS NEMATURA (Lichtenstein).

Myiothera nematura LICHTENSTEIN, VERZ. DOUBL., 1823, p. 43.

Lochmias nematura BONAPARTE, CONSP. AVIUM, I, 1850, p. 210.

The single specimen is rather darker, duller, and less rufescent above than one from Brazil, but otherwise does not differ. "Iris brown." There is a good deal of variation in color among examples of this species, but it seems to be entirely individual, not geographical.

FURNARIUS RUFUS (Gmelin).

Merops rufus GMELIN, SYST. NAT., I, 1788, p. 465.

Furnarius rufus D'ORBIGNY, VOYAGE AMÉR. MÉRID., OIS., 1835-44, p. 250.

One specimen; appreciably darker on the breast and upper parts than examples from Buenos Ayres; but whether or not this difference is geographical is inconclusively shown by the material at hand. "Iris brown."

Family COTINGIDÆ.

PACHYRHAMPHUS VIRIDIS (Vieillot).

Tityra viridis VIEILLOT, NOUV. DICT. D'HIST. NAT., III, 1816, p. 348.

Pachyrhampus viridis SCLATER, PROC. ZOOL. SOC. LOND., 1857, p. 75.

A single adult male is in the collection. "Iris brown."

The basis of Vieillot's *Tityra viridis* was Azara's Paraguay bird, the present example coming thus from the type locality. The bird of eastern Brazil, however, is much smaller and slightly paler, being

apparently separable as a geographical race. Five males from Bahia, Brazil, average in measurement of wing, 72 mm., of tail, 56 mm.; while the present Paraguay example has a wing of 78 mm., and a tail of 62 mm. The earliest name available for the Brazilian race is *curierii* Swainson;¹ and the proper combination is *Pachyrhamphus viridis curierii*.

Family PIPRIDÆ.

SCOTOTHORUS UNICOLOR (Bonaparte).

Heteropelma unicolor BONAPARTE, Consp. Av. Volucr. Anisod., 1854, p. 4.

Scotothorus unicolor OBERHOLSER, Proc. Acad. Nat. Sci. Phila., 1899, p. 209.

Heteropelma virescens AUCT.

One example, apparently typical. "Iris brown."

CHIROXIPHIA CAUDATA (Shaw).

Pipra caudata SHAW, Nat. Miscell., V, 1794, pl. CLIII.

Chiroxiphia caudata CABANIS, Wiegmann's Archiv f. Naturg., 1847, I, p. 235.

Three specimens. "Iris brown." One of these is an immature male, and differs from the adult female as follows: Whole crown scarlet; throat, sides of head and neck mixed with blackish; under surface tinged with bluish.

Family TYRANNIDÆ.

MYIARCHUS FEROX (Gmelin).

Muscicapa ferox GMELIN, Syst. Nat., I, 1788, p. 934.

Myiarchus ferox CABANIS, Wiegmann's Archiv f. Naturg. (Ornith. Notiz.), I, 1847, p. 248.

One specimen, closely resembling birds from Guiana, differing only in the more rufescent tinge to the upper tail-coverts, and in the darker, more reddish edgings to the wing-coverts. "Iris brown."

Judging from specimens in the United States National Museum collection, *Myiarchus ferox* is entirely distinct from *Myiarchus pelzelni* Berlepsch.² The latter is lighter ashy on the breast, much paler, more grayish above, and has a decidedly paler bill.

BLACICUS PILEATUS (Ridgway).

Contopus pileatus RIDGWAY, Proc. U. S. Nat. Mus., VIII, 1885, p. 21.

Blacicus pileatus OBERHOLSER, Auk, XVI, 1899, p. 337.

A single adult male of this very distinct species is of particular interest, since it reveals for the first time the region in which the bird may be found. The species was originally described from a single specimen without indicated locality, which Mr. Ridgway discovered among the collections of the American Museum of Natural History in

¹*Psaris curierii*, Zool. Illust., I, 1820-21, pl. xxxii.

²Ibis, 1883, p. 139.

New York City, and which until now has remained unique. The present example has been carefully compared with the type, and there is no doubt of their identity; though the former is somewhat more ochraceous on the central portion of the abdomen, as well as darker, slightly more greenish olive throughout, this difference, of course, to be expected, for the type was for a long time mounted, and through exposure to light has become somewhat faded. Our specimen measures: wing, 76 mm.; tail, 65 mm.; exposed culmen, 11 mm.; tarsus, 13.5 mm.; middle toe, 8 mm. "Iris brown."

SIRYSTES SIBILATOR (Vieillot).

Muscicapa sibilator VIEILLOT, Nouv. Dict. d'Hist. Nat., XXI, 1818, p. 457.

Syrstes sibilator CABANIS and HEINE, Mus. Hein., II, 1859, p. 75.

One female. "Iris brown." The edgings of the wing-coverts in this example are entirely ochraceous, apparently a lingering mark of immaturity. The longer lower tail-coverts are pale ochraceous, and the black upper tail-coverts are narrowly margined with chestnut.

RHYNCHOCYCLUS SULPHURESCENS (Spix).

Platyrrhynchus sulphurescens SPIX, Av. Spec. Nov. Bras., II, 1825, p. 10, pl. XII, fig. 1.

Rhynchocyclus sulphurescens CABANIS and HEINE, Mus. Hein., II, 1859, p. 56.

One adult female, July 21, 1900. "Iris light brown."

This species is quite certainly divisible into several geographical races, but sufficient material is not at present accessible to render advisable any such attempt. Birds from Matto Grosso, Brazil, are identical with the one here chronicled from Paraguay, and those from Trinidad are not appreciably different.

SUIRIRI SUIRIRI (Vieillot).

Muscicapa suiriri VIEILLOT, Nouv. Dict. d'Hist. Nat., XXI, 1818, p. 487.

Suiriri suiriri D'ORBIGNY, Voyage Amér. Mérid., Ois., 1835-44, p. 336.

One adult female. "Iris brown." This is a typical specimen, as Vieillot's name was based on the "Suiriri ordinario" of Azara. The bird described by Gould as *Pachyramphus albescens*,¹ from Buenos Ayres, good specimens of which are in the United States National Museum, represents a recognizable subspecies which should be known as *Suiriri suiriri albescens*. It differs from the true *suiriri* in being rather more grayish on the upper surface, but principally in having the wing-bars and outer margins of the secondaries almost pure white instead of dull olive gray.

The proper generic name for this group is *Suiriri* d'Orbigny,² as it seems to be entirely pertinent, and of very much earlier date than *Empidagra* Cabanis and Heine.³

¹ Zool. Voyage Beagle, III, 1841, p. 50, pl. xiv.

² Voyage Amér. Mérid., Ois., 1835-44, p. 336.

³ Mus. Hein., II, 1859, p. 59.

MYIOPAGIS CANICEPS (Swainson).

Tyrannula caniceps SWAINSON, Birds Brazil, 1835 (?), pl. XLIX.

Myiopagis caniceps SHARPE, Hand-List Gen. Spec. Birds, III, 1901, p. 117.

A fine adult male of this very rare and very distinct species is in the collection. It differs in some respects from typical members of the genus *Myiopagis* in its more slender bill and greater relative length of the two outer primaries, but is undoubtedly much more satisfactorily placed here than in *Elænia*. This specimen may be described as follows:

Crown plumbeous, with slaty shaft streaks and washed with olive green; the basal portion of the crest feathers white, mixed with pale sulphur yellow, forming a lengthened, almost concealed vertical spot; remainder of upper surface rather paler than the crown, olive green, brightest and clearest on rump, increasingly mingled with plumbeous anteriorly until completely merging into the color of the pileum; tail fuscous, bordered with olive green; wings sepia brown, the lesser coverts and outer margins of primaries olive green, the outer edges of secondaries, with tips of greater and lesser wing-coverts pale sulphur yellow; the sides of head and neck plumbeous, mixed with greenish on the latter, the auriculars with whitish shaft streaks, the eye ring and suborbital region mixed with grayish white; lower surface dull white, the breast and sides of throat shaded with plumbeous, the sides, flanks and crissum tinged with sulphur yellow, this on the sides slightly mingled with greenish; lining of wing pale sulphur yellow; inner margins of wing-quills buffy white. "Iris buff." Length of wing, 59 mm.; tail, 54 mm.; exposed culmen, 9.5 mm.; tarsus, 18 mm.; middle toe, 11.5 mm.

ELÆNIA PAGANA PAGANA (Lichtenstein).

Muscicapa pagana LICHTENSTEIN, Verz. Doubl., 1823, p. 54.

Elænea pagana CABANIS, in Schomburgk's Reis. Guian., III, 1848, p. 701.

One female. "Iris brown."

PHYLLOMYIAS SALVADORII (Dubois).

Phyllomyias berlepschi SALVADORI, Boll. Mus. Torino, XII, 1897, No. 292, p. 13 (not Sclater).

Phyllomyias brevirostris var. *salvadorii* DUBOIS, Synop. Avium, Pt. 4, 1900, p. 238.

A single adult specimen belongs undoubtedly to this newly described species. It measures as follows: Wing, 62.5 mm.; tail, 60 mm.; exposed culmen, 8 mm.; tarsus, 18 mm.; middle toe, 10.5 mm. "Iris brown."

LEPTOPOGON AMAUROCEPHALUS ICASTUS Oberholser.

Leptopogon amaurocephalus icastus OBERHOLSER, Proc. Biol. Soc. Washington, XIV, 1901, p. 187.

Chars. subsp.—Similar to *Leptopogon amaurocephalus tristis*, but larger, crown more brownish, the anterior lower surface less purely yellow, and the wing-bands pale ochraceous instead of pure yellow.

Description.—Type, adult male, No. 173405, U.S.N.M.; Sapucay, Paraguay, July 23, 1900; William T. Foster. Crown and occiput olive brown, but little darker than the pure olive green of the remainder of the upper surface, and into which it almost insensibly passes on the nape; upper tail-coverts slightly more brownish than the back; tail fuscous, edged with olive green; wings sepia brown, the remiges margined externally with olive green, internally with buff, the lesser coverts olive green, the others edged with the same, the median and greater series with broad tips of pale ochraceous, forming two well-defined wing-bands; lores and orbital region brownish white, mixed with olive brown; cheeks mingled greenish, brownish, and whitish; auriculars anteriorly brownish white, posteriorly deep olive brown, this forming a conspicuous patch; sides of neck grayish olive green; chin and upper throat grayish white, washed with olive yellow; rest of ventral surface sulphur yellow, much shaded with olive green on jugulum, breast, and sides; lining of wing sulphur yellow, the bend of wing tinged with, ochraceous; bill brownish black, the basal half of mandible dull white. "Iris brown." Length of wing, 69 mm.; tail, 63 mm.; exposed culmen, 11 mm.; tarsus, 16 mm.; middle toe, 9 mm.

This apparently new form is perhaps nearest *Leptopogon amaurocephalus amaurocephalus*, from which, however, it differs in its somewhat larger size, less ochraceous wing-bands, and paler, much less brownish, less well-defined cap.

Dr. Allen¹ is seemingly quite right in asserting the close relationship of *Leptopogon amaurocephalus*, *L. a. pileatus*, and *L. a. tristis*, and considering them simply as geographical forms of one wide-ranging species. *Leptopogon a. pileatus* may easily be distinguished from true *amaurocephalus* by its darker, more ochraceous lower surface, more yellowish green upper parts, and warmer brown pileum.

ORCHILUS AURICULARIS (Vieillot).

Platyrrhynchus auricularis VIEILLOT, Nouv. Dict. d'Hist. Nat., XXVII, 1818, p. 16.
Orchilus auricularis CABANIS and HEINE, Mus. Hein., II, 1859, p. 51.

A single example is like one from Brazil, except for rather darker, richer colors above as well as on sides of head and neck. The latter, however, may possibly be a female. "Iris brown."

¹Bull. Amer. Mus. Nat. Hist., IV, 1892, p. 334.

EUSCARTHMUS MARGARITACEIVENTER (D'Orbigny and Lafresnaye).

Todirostrum margaritaceiventer D'ORBIGNY and LAFRESNAYE, Synop. Avium, I, 1837, p. 46.

Euscarthmus margaritaceiventris SCLATER and SALVIN, Proc. Zool. Soc. Lond., 1879, p. 612.

One specimen in perfect plumage. "Iris buff."

There are possibly two species at present united by authors under *E. margaritaceiventer*. The above example agrees with the original description of *margaritaceiventer* in being distinctly, even conspicuously, streaked on chin, throat, and breast. Dr. Sclater, however, describes this species as being without streaking on the lower surface,¹ though he fails to note that this is not in correspondence with the original description. If the birds prove really to be representatives of two forms, the name for the nonstreaked species is probably *Euscarthmus wuchereri* Sclater and Salvin,² the diagnosis of which seems to indicate such a difference from true *E. margaritaceiventer*.

MACHETORNIS RIXOSUS (Vieillot).

Tyrannus rixosus VIEILLOT, Nouv. Dict. d'Hist. Nat., XXXV, 1819, p. 85.

Machetornis rixosus BURMEISTER, Syst. Ueber. Vög. Bras., II, 1856, p. 514.

A single female; apparently identical with birds from Brazil and Buenos Ayres. "Iris brown."

COPURUS COLONUS (Vieillot).

Muscicapa colonus VIEILLOT, Nouv. Dict. d'Hist. Nat., XXI, 1818, p. 448.

Copurus colonus CABANIS and HEINE, Mus. Hein., II, 1859, p. 41.

One adult male. "Iris brown." The head is rather more grayish than in the adult specimens available for comparison, but whether this is due to age or to geographical variation is not evident from our material.

LICHENOPS PERSPICILLATA (Gmelin).

Motacilla perspicillata GMELIN, Syst. Nat., I, 1788, p. 969.

Lichenops perspicillatus GOULD, Zool. Voy. Beagle, III, 1841, p. 51, pl. 1x.

Two specimens. "Iris buff [young male]; iris yellow [adult male]." This immature male is quite similar to the adult female, but is darker and is more broadly streaked on the upper parts, breast, and lower tail-coverts.

KNIPOLEGUS CYANIROSTRIS (Vieillot).

Muscicapa cyanirostris VIEILLOT, Nouv. Dict. d'Hist. Nat., XXI, 1818, p. 447.

Cnipolegus cyanirostris BONAPARTE, Consp. Avium, I, 1850, p. 195.

Two specimens, apparently typical. "Iris red [adult male]; iris brown [adult female]."

¹ Cat. Birds Brit. Mus., XIV, 1888, pp. 78, 80.

² Nomenclator Avium Neotrop., 1873, p. 158.

Family TROGLODYTIDÆ.

TROGLODYTES MUSCULUS Naumann.

Troglodytes musculus NAUMANN, Vög. Deutschl., III, 1823, p. 724, table (Lichtenstein manuscript).

One specimen. "Iris brown." This bird belongs apparently to the dark race from southern Brazil, to which the name *musculus* is applicable. It is identical with another specimen from the Parana River, and much darker, more rufescent both above and below than the birds from Buenos Ayres.

Family VIREONIDÆ.

CYCLARHIS VIRIDIS (Vieillot).

Saltator viridis VIEILLOT, Encyc. Méth., II, 1823, p. 793.

Cyclorhis viridis BURMEISTER, Syst. Ueber. Thiere Bras., III, 1856, p. 107.

One adult male. "Iris orange."

CYCLARHIS OCHROCEPHALA Tschudi.

Cyclarhis ochrocephala TSCHUDI, Wiegmann's Archiv f. Naturg., I, 1845, p. 362.

One specimen, an adult female. "Iris brownish red."

Family CORVIDÆ.

CYANOCORAX HECKELII Pelzeln.

Cyanocorax heckelii PELZELN, Sitz. k. Akad. Wiss. Wien, XX, 1856, p. 163.

A single unsexed, undated specimen of this rare and very handsome jay is in the collection. It is in excellent plumage and apparently entirely typical. Wing, 183 mm.; tail, 159 mm.; exposed culmen, 28.5 mm.; tarsus, 46 mm.

Family CEREBIDÆ.

DACNIS CAYANA (Linnæus).

Motacilla cayana LINNÆUS, Syst. Nat., 12th ed., I, 1766, p. 336.

Dacnis cayana STRICKLAND, Contr. Orn., 1851, p. 15.

Two specimens, both of which seem to be rather darker and duller above than ordinary examples. "Iris light brown [male];" "iris brown [female]."

ATELEODACNIS SPECIOSA (Maximilian.)

Sylvia speciosa MAXIMILIAN, Beitr. Naturg. Bras., III, 1830, p. 708.

Two specimens. "Iris brown [male];" "iris light brown [female]." The male is not quite adult, having still a wash of yellowish olive on the upper parts, most of the wing-quills with yellowish green outer

margins, and many pale buffy feathers on the under surface, where they contrast plainly with the incoming feathers of the pale gray perfect plumage.

Mr. Ridgway has directed our attention to the structural differences obtaining between the so-called "*Dacnis*" *speciosa* and *Dacnis cayana*—differences that obviously necessitate generic separation, the name *Atleodacnis* Cassin¹ being applicable to the former. The other species of this group are:

Atleodacnis leucogenys (Lafresnaye) (type of genus).

Atleodacnis analis (d'Orbigny and Lafresnaye).

Atleodacnis plumbea (Latham).

(?) *Atleodacnis salmoni* (Selater).

Family MNIOTILTIDÆ.

BASILEUTERUS AURICAPILLUS (Swainson).

Scotophaga auricapilla SWAINSON, Anim. in Menag., 1837, p. 293.

Basileuterus auricapillus SHARPE, Cat. Birds Brit. Mus., X, 1885, p. 393.

One specimen. "Iris brown." The birds from northern South America are rather darker and decidedly more brownish above than those from Brazil and Paraguay, and are worthy of subspecific recognition.

This species is usually called *Basileuterus vermivorus*, but this name² refers primarily to *Sylvia vermivora* Latham,³ which is *Helminthacus vermivorus* (Gmelin); and the designation above given is therefore the proper one.

BASILEUTERUS LEUCOBLEPHARUS CALUS Oberholser.

Basileuterus leucoblepharus calus OBERHOLSER, Proc. Biol. Soc. Washington, XIV, 1901, p. 188.

Chars. subsp.—Similar to *Basileuterus leucoblepharus leucoblepharus*, but slate color of head and neck darker, less brownish; olive green of back and rump less yellowish; breast much more heavily shaded with slate gray; sides and flanks almost pure slate gray, instead of olive green mixed with pale brownish gray; crissum yellowish white instead of olive yellow; bill darker brown.

Description.—Type, adult male, No. 173448, U.S.N.M.: Sapucay, Paraguay, July 1, 1900; William T. Foster. Pileum and nape slate color; a sharply defined line extending backward from the base of bill on each side of the crown, slate black; rest of upper surface plain olive green; tail similar, with rather lighter edgings; remiges fuscous,

¹Proc. Acad. Nat. Sci. Phila., 1864, p. 270.

²*Sylvia vermivora* Vieillot, Nouv. Dict. d'Hist. Nat., XI, 1817, p. 278.

³Index Orn., II, 1790, p. 544.

all the exposed portions of the wings quite similar in color to the back; supraloral area and eye ring white; lores slate color; no well-defined superciliary stripe; cheeks, sides of throat and neck slate color, all but the last somewhat mixed with whitish; chin and center of throat white, sharply defined laterally and against the slate gray of the breast; center of the breast heavily mottled with slate gray, the sides of the same, together with sides of body and the flanks, deep slate gray, the latter very slightly mingled with olive green; median portion of abdomen white; under tail-coverts pale yellowish; bend of wing and axillars lemon yellow. Bill dark brownish slate; feet pale; "iris brown." Length of wing, 65.5 mm.; tail, 67 mm.; exposed culmen, 11 mm.; tarsus, 25 mm.; middle toe, 14 mm.

There seems to be little, if any, difference in size between *calus* and true *leucoblepharus*, but if anything, the former is slightly smaller. The only name which could by any possibility apply to this new form is *Trichas superciliosus* Swainson,¹ and this appears to be undoubtedly a pure synonym of *Basileuterus leucoblepharus leucoblepharus*.

GEOTHYLPIS ÆQUINOCTIALIS VELATA (Vieillot).

Sylvia velata VIEILLOT, Ois. Amér. Sept., II, 1807, p. 22, pl. LXXIV.

Geothlypis velata CABANIS, Mus. Hein., I, 1850, p. 16.

One specimen in perfect plumage, entirely typical of this form. "Iris light brown." Some specimens from western Brazil apparently indicate intergradation with *auricularis*, while others from the north-eastern part of this country approach *æquinoctialis*. There are at least four good subspecies of *Geothlypis æquinoctialis*, as follows:

Geothlypis æquinoctialis æquinoctialis (Gmelin).—Northern South America, from Trinidad and Guiana to Colombia, and probably north-eastern Peru.

Geothlypis æquinoctialis velata (Vieillot).—Eastern and southern Brazil to northern Argentine Republic, southeastern Peru, and possibly Chile.

Geothlypis æquinoctialis auricularis (Salvin).—Western Peru.

Geothlypis æquinoctialis chiriquensis (Salvin).—Veragua, U. S. Colombia.

Although *Sylvia cucullata* Latham² antedates *Sylvia velata*³ Vieillot for this species, to which attention has been called by Dr. Richmond,⁴ the combination *Geothlypis cucullata* can not be employed for this bird, since it was long previously used as the original designation of a Mexican bird described by Salvin and Godman.⁵

¹ Anim. in Menag., 1837, p. 295.

² Index Orn., II, 1790, p. 528.

³ Ois. Amér. Sept., II, 1807, p. 22, pl. LXXIV.

⁴ Auk, XVII, 1900, p. 179.

⁵ Ibis, 1889, p. 237.

COMPSOTHLYPIS PITIAYUMI PITIAYUMI (Vieillot).

Sylvia pitiayumi VIEILLOT, Nouv. Dict. d'Hist. Nat., XI, 1817, p. 276.

Compsothlypis pitiayumi CABANIS, Mus. Hein., I, 1850, p. 21.

One specimen, belonging without doubt to the typical form, rather than to the larger, darker and more richly colored race from northern and western South America, *Compsothlypis pitiayumi pacifica*. "Iris brown."

Family ICTERIDÆ.

ICTERUS PYRRHOPTERUS (Vieillot).

Agelaius pyrrhopterus VIEILLOT, Nouv. Dict. d'Hist. Nat., XXXIV, 1819, p. 543.

Icterus pyrrhopterus D'ORBIGNY and LAFRESNAYE, Synop. Avium, II, 1838, p. 6.

One adult male, apparently identical with Bolivian specimens. "Iris brown."

Family TANAGRIDÆ.

TRICHOThRAUPIS QUADRICOLOR (Vieillot).

Tachyphonus quadricolor VIEILLOT, Nouv. Dict. d'Hist. Nat., XXXII, 1819, p. 359.

Trichothraupis quadricolor CABANIS, Mus. Hein., I, 1850, p. 23.

Two specimens. "Iris brown." The immature male of this species differs from the adult in being darker, more brownish olive above, and more deeply ochraceous below; the yellow coronal patch is wanting, but is indicated by the pale yellow bases of the feathers of the vertex, the amount of this color increasing with age.

PHENICOTHRAUPIS RUBICA (Vieillot).

Stalator [sic] *rubicus* VIEILLOT, Nouv. Dict. d'Hist. Nat., XIV, 1817, p. 107.

Phenicothraupis rubica CABANIS, Mus. Hein., I, 1850, p. 24.

One specimen, an adult male, apparently typical. "Iris brown."

NEMOSIA GUIRA (Linnæus).

Motacilla guira LINNÆUS, Syst. Nat., 12th ed., I, 1766, p. 335.

Nemosia guira BONAPARTE, Consp. Avium, I, 1850, p. 236.

Two specimens, male and female. "Iris brown."

Birds from Paraguay and southwestern Brazil are uniformly of large size, while those from eastern South America (Brazil to Venezuela) seem to average smaller; but whether or not this character is sufficiently constant to warrant the recognition of two geographical races the present material does not show. There is no observable difference in color.

EUPHONIA PECTORALIS (Latham).

Pipra pectoralis LATHAM, Index Orn., Suppl., 1801, p. lviii.

Euphonia pectoralis BONAPARTE, Consp. Avium, I, 1850, p. 233.

One adult male. "Iris brown."

EUPHONIA VIOLACEA (Linnæus).

Fringilla violacea LINNÆUS, Syst. Nat., 10th ed., I, 1758, p. 182.

Euphonia violacea MAXIMILIAN, Beitr. Naturg. Bras., III, 1830, p. 439.

Two specimens, male and female. "Iris brown."

While there seems to be no constant color difference between birds from Guiana and those from southern Brazil and Paraguay, yet the northern race is so much smaller that its recognition by name is well deserved. Dr. Scater considered¹ the Guiana bird to be the typical form; but Linnæus' description, in so far as it is possible to determine, was based on the bird from Brazil, being, moreover, so considered by Cabanis when he separated the race from Cayenne;² and consequently the latter is the one that should be called *Euphonia violacea lichtensteini*, unless, indeed, Lichtenstein's prior name be considered tenable,³ in which case it would stand as *Euphonia violacea minor*.

CHLOROPHONIA CHLOROCAPILLA (Shaw).

Pipra chlorocapilla SHAW, Gen. Zool., XIII, Pt. 2, 1826, p. 255.

Tanagra viridis VIEILLOT, Nouv. Dict. d'Hist. Nat., XXXII, 1819, p. 426.

Chlorophonia viridis BONAPARTE, Rev. Zool., 1851, p. 137.

One specimen, an adult male, of which the colors are very rich, particularly the blue of the upper surface, this approaching indigo on the back. "Iris brown."

Vieillot's specific name *viridis*, commonly employed for this species, is preoccupied by *Tanagra viridis* Müller,⁴ which has been considered a synonym of *Calospiza tatao*. The proper name for *Chlorophonia viridis* Auct. is therefore as above given.

Family FRINGILLIDÆ.

PYRRHOCOMA RUFICEPS (Strickland).

Tachyphonus ruficeps STRICKLAND, Ann. and Mag. Nat. Hist., XIII, 1844, p. 419.

Pyrrhocomma ruficeps CABANIS, Mus. Hein., I, 1851, p. 138.

Two specimens, male and female. "Iris [of both] brown." The male is of a rather clearer slate color, both above and below, than examples from Brazil, and has a somewhat paler throat, though otherwise does not differ.

CORYPHOSPINGUS CUCULLATUS (Müller).

Fringilla cucullata MÜLLER, Syst. Nat., Anhang, 1776, p. 166.

Fringilla cristata GMELIN, Syst. Nat., I, 1788, p. 926.

Two specimens, male and female. The latter is darker throughout than the three others of the same sex available for comparison. The iris of both sexes is given as brown by the collector.

¹ Cat. Birds Brit. Mus., XI, 1886, p. 74.

² *Phonasca lichtensteini* Cabanis, Journ. für Orn., 1860, p. 331.

³ *Euphonia violacea* var. *minor* Lichtenstein, Verz. Doubl., 1823, p. 29.

⁴ Syst. Nat., Anhang, 1776, p. 158.

This species, the *Coryphospingus cristatus* of authors, should be called *Coryphospingus cucullatus*, as Müller's long-neglected name has a number of years priority.

ARREMON CALLISTUS Oberholser.

Arremon callistus OBERHOLSER, Proc. Biol. Soc. Washington, XIV, 1901, p. 188.

Chars. sp.—Much like *Arremon polionotus*, but upper parts darker; black jugular band broader; wing without a yellowish olive green humeral patch; bend of wing white; size slightly larger.

Description.—Type, adult male, No. 173425, U.S.N.M.; Sapucay, Paraguay, July 22, 1900; William T. Foster. Pileum black, the occiput centrally slate color; rest of upper surface slate color; tail slate black, narrowly margined with slate; wings blackish slate, the quills edged with the color of the back, the exposed portions of secondary coverts entirely slate color, with a very slight yellowish olive wash on the lesser series, the alula and primary coverts black, the edge of the wing at the wrist white with a faint tinge of yellowish; sides of head black, a broad white stripe leading from above the eye on each side to the nape; sides of neck slate color; entire under surface white, the jugulum with a rather (10 millimeters) wide black band, reaching laterally halfway up the sides of the neck; sides of breast slate color; sides of body, flanks and lining of wing slate gray, the last with also some white and some slate color. Mandible and basal half of maxillary tomia yellowish orange, remainder of maxilla black; "iris brown." Length of wing, 80 mm.; tail, 73 mm.; exposed culmen, 12.5 mm.; tarsus, 24 mm.; middle toe, 16.5 mm.

The above-described specimen, which is the only one sent by Mr. Foster, differs so much from all of a large series of *Arremon polionotus* with which it has been compared that it seems impossibly identifiable with that species. The discrepancies are not such as can be attributed to sex, age, or even to individual peculiarity; the bird is undoubtedly an adult male, and as such has been treated. With species other than *polionotus* it needs no comparison.

EMBERIZOIDES MACROURUS HERBICOLA (Vieillot).

Sylvia herbicola VIEILLOT, Nouv. Dict. d'Hist. Nat., XI, 1817, p. 192.

Emberizoides herbicola SHARPE, Cat. Birds Brit. Mus., XIII, 1888, p. 769.

One specimen, an adult female. "Iris light brown." This form is apparently well entitled to subspecific recognition, for though but little different in size, the almost invariably unstreaked crissum serves for its easy recognition.

EMBERNAGRA PLATENSIS (Gmelin).

Emberiza platensis GMELIN, Syst. Nat., I, 1788, p. 886.

Embernagra platensis D'ORBIGNY, Voyage. Amér. Mérid., Ois., 1835-44, p. 284.

The single specimen is rather more grayish above and less buffy

below than examples from Buenos Ayres, but this is probably due to its fresh plumage. "Iris brown."

MYOSPIZA MANIMBE (Lichtenstein).

Fringilla manimbe LICHTENSTEIN, Verz. Doubl., 1823, p. 25.

One example, an adult male in freshly molted plumage. "Iris brown." There seem to be absolutely no constant characters to support the separation of the birds of this region as a subspecies *dorsalis*.¹

BRACHYSPIZA CAPENSIS CAPENSIS (Müller).

Fringilla capensis MÜLLER, Syst. Nat., Anhang, 1776, p. 165.

Brachyspiza capensis RIDGWAY, Auk, XV, 1898, p. 321.

One specimen, an adult male. "Iris light brown."

SYCALIS PELZELNI Sclater.

Sycalis pelzelni SCLATER, Ibis, 1872, p. 42.

One specimen in fresh plumage. The flanks and sides are very obscurely streaked, and the dull pectoral band is conspicuous. The orange yellow of the forehead is much obscured by dusky. "Iris brown."

SPOROPHILA ALBOGULARIS (Spix).

Loxia albogularis SPIX, Av. Gen. et. Spec. Nov. Bras., II, 1824, p. 46, pl. LX, figs. 1, 2.

Sporophila albogularis CABANIS, Mus. Heil., I, 1851, p. 149.

A single female *Sporophila* belongs apparently to this species. "Iris brown."

CYANOLOXIA GLAUCOCÆRULEA (d'Orbigny).

Pyrhula glaucocerulea D'ORBIGNY, Voy. Amér. Mérid., Ois., 1835-44, pl. L, fig. 2.

Cyanoloxia glaucocerulea BONAPARTE, Consp. Avium, I, 1850, p. 503.

Two specimens. "Iris brown." One of these is an immature male just beginning to assume the blue plumage of the adult, in which condition it is paler below than the adult female. The other example is an adult female, but is darker, particularly above, than another of the same sex, in this approaching *Cyanocompsa sterea*, though in other respects remaining typical of *C. glaucocerulea*.

CYANOCOMPSA STEREA Oberholser.

Cyanocompsa sterea OBERHOLSER, Proc. Biol. Soc. Washington, XIV, 1901, p. 188.

Chars. sp.—Similar to *Cyanocompsa cyanea*, but bill much smaller; the blue of forehead and crown less purplish; the female much deeper, less rufescent brown, particularly on the upper surface.

¹ Ridgway, Hist. N. Am. Land Birds, I, 1874, p. 549.

Description.—Type, immature male, No. 173416, U.S.N.M.; Sapucay, Paraguay, July 21, 1900; William T. Foster. Upper parts deep umber brown, rather paler on nape and rump, more rufescent on the latter; crown and forehead dull blue, the forehead lighter and more greenish; wings and tail sepia brown, the wing-coverts and outer margins of the wing-quills like the back, some blue like that of the head showing on the bend of the wing; sides of the head and neck dull deep brown, with some admixture of bluish, the lores deep buff; entire under surface brown, much paler and more rufescent than that of the upper parts, lightest on the chin and middle of the abdomen. Wing, 73 mm.; tail, 67 mm.; exposed culmen, 12 mm.; depth of bill at base, 10.5 mm.; tarsus, 18 mm.; middle toe, 14.5 mm.

A female taken June 23, 1900, is quite similar to the immature male, except for the lack of all bluish trace, and being of a noticeably more rufous hue throughout. Wing, 71 mm.; tail, 65 mm.; exposed culmen, 12.5 mm.; depth of bill at base, 10 mm.; tarsus, 21 mm.; middle toe, 15 mm.

The two specimens of this new species have been carefully compared with a good series of *Cyanocompsa cyanea* from various parts of its range, and they are certainly distinct. Unfortunately the male is not adult, but enough of blue shows on the head and bend of the wing to indicate a color as well as a size difference from *Cyanocompsa cyanea*. Compared with *Cyanocompsa glaucocerulea* it has a very much larger and differently shaped bill, though in other dimensions there seems to be no material difference; what there is of blue color is darker, decidedly less greenish; the female is also much more deeply colored throughout. In fact this new species is in nearly all of its characters to some extent intermediate between *Cyanocompsa cyanea* and *Cyanoloxia glaucocerulea*.

THE REPTILES OF THE HUACHUCA MOUNTAINS, ARIZONA.

By LEONHARD STEJNEGER,

Curator of the Division of Reptiles and Batrachians

Few places in southern Arizona have been so well searched for reptiles and by so many collectors as Fort Huachuca and the small mountain stock back of it, the Huachuca Mountains.

Many years ago Lieut. Harry C. Benson, then stationed at the fort, sent the United States National Museum a small but very interesting lot of specimens. Dr. Timothy E. Wilcox, the surgeon of the fort for many years, has made very exhaustive collections there, and some of the most interesting specimens were secured by him. Dr. A. K. Fisher has added materially to our knowledge of the herpetology of that locality during his visit there in 1892. I myself spent a few days at Fort Huachuca during the early part of November, 1889, but the season was too far advanced for any successful collecting.

In the following list I have incorporated the additional species collected by Mr. W. W. Price in the Huachuca Mountains during 1893 and 1894. His collection is now the property of Leland Stanford Junior University, and has been most ably reported upon by Mr. John van Denburgh.¹

CHELONIA.

KINOSTERNON SONORIENSE Le Conte.

This mud turtle occurs in the first "cienega" in the canyon above the fort, about 5,300 feet above the sea, whence we have six specimens collected by Dr. Wilcox (Nos. 17779-17781; 19680; 21120-21121). Dr. Fisher has informed me that this species is common in Babacomari Creek.

SAURIA.

CROTAPHYTUS BAILEYI Stejneger.

One specimen from Lieutenant Benson (No. 14748), one from Mr. Loring (No. 22208), and four from Dr. Wilcox (Nos. 19704-19707) tes-

¹Proc. Cal. Acad. Sci., (2) VI, August 18, 1896, pp. 338-349.

tify to its occurrence at Fort Huachuca. Dr. Fisher also collected it at Fort Bowie (No. 22207).

HOLBROOKIA MACULATA APPROXIMANS Baird.

Collected at Fort Huachuca by Dr. Wilcox (Nos. 17787; 19708-19722; 21118-21119), Dr. Mearns (No. 21042), and Dr. Fisher (Nos. 22209-22214).

UTA SYMMETRICA Baird.

Exceedingly numerous. Lieutenant Benson sent in two specimens (Nos. 14750-14751); Dr. Wilcox fifteen (Nos. 17786; 19690-19703); Dr. Fisher twenty-five (Nos. 22236-22260); and I, myself, obtained two as late as the beginning of November (Nos. 15760-15761). They are found from the Fort itself at least up to 6,700 feet altitude in the mountains.

SCELOPORUS SCALARIS Wiegmann.

This species has been collected in the Huachuca Mountains only by Mr. Price. Mr. van Denburgh writes:

Mr. Price's notes indicate that this is a rock-dwelling species, and that it occurs at great altitudes. The specimens collected furnish, I believe, the most northern record of its range. They are quite typical, and were collected near the summit of the Huachuca Mountains, May 22, 1894, in Morses Canyon, April 7, 1894, and at an altitude of 9,500 feet in the Huachuca Mountains, July 22, 1893.¹

SCELOPORUS CLARKII Baird and Girard.

Apparently common, both at the Fort and in the mountains. Dr. Wilcox has sent six specimens (Nos. 17782; 19684-19686; 21113-21114), one of which was taken in a room in his house, while Dr. Fisher collected ten (Nos. 22218-22227), some as high up as 6,000 feet altitude.

The more specimens one sees of this species the more one wonders that it was ever confounded with *S. magister*. The latter does not occur in the Huachuca.

SCELOPORUS JARROVII Cope.

This lizard is one of the most common species in the Huachuca Mountains, as testified by numerous specimens collected by Dr. Fisher (Nos. 22228-22231), Dr. Wilcox (Nos. 19687-19689 and 21115-21117), and myself (Nos. 15756-15759). It was also collected there by Mr. Price.²

I found Yarrow's lizard among exposed rocks at various places between 5,700 feet and 6,700 feet altitude during the first days of November, 1889. The nights were very cool and the lizards did not come out from the cracks and crevices in the rocks until toward noon, when they could be found sunning themselves on the whitish rocks,

¹ Proc. Cal. Acad. Sci., (2) VI, p. 341.

² Idem, (2) VI, p. 342.

against which their dark bodies formed a violent contrast. As a matter of fact, when alive or recently killed, they were of a uniform "dead" sooty black, without the slightest trace of the white collar stripes. When picking up these black lizards with the exceedingly rough and prickly scale covering I did not doubt that I had before me an undescribed species, remembering well that *S. jarrovi* was originally characterized as having a very smooth pholidosis. Great was my amazement, however, on returning to my quarters and unpacking my booty to find that these dull black animals had changed in the bag to a very gorgeous blue with a broad black collar most distinctly set off by white margins. I suppose the blackness was due to the cool temperature and that the brilliant colors are chiefly in evidence during warm weather.

PHRYNOSOMA HERNANDESI (Girard).

This seems to be the commonest species of horned-toad at Huachuca, five specimens having been sent in by Dr. Wilcox (Nos. 17783, 17784; 19681-19683) and four by Dr. Fisher (Nos. 22316, 22232-22234). It was also collected there by Mr. Price.¹

PHRYNOSOMA CORNUTUM (Harlan).

One specimen (No. 21001) has been collected at Fort Huachuca by Dr. Wilcox. Dr. Fisher has obtained another at Wilcox, Cochise County, and Mr. Price a third at Fairbank.¹

GERRHONOTUS KINGII Gray.

Mr. Price obtained three specimens of this species in the Huachuca Mountains during July and August, 1893.¹

CNEMIDOPHORUS GULARIS Baird and Girard.

Four specimens by Dr. Wilcox (Nos. 17785, 19723-19725) and two by Dr. Fisher, from Fort Huachuca.

CNEMIDOPHORUS TIGRIS MELANOSTETHUS (Cope).

According to van Denburgh this species was obtained in the Huachuca Mountains by Mr. Price.²

SERPENTES.

DIADOPHIS REGALIS Baird and Girard.

A specimen of this species, typical in every respect, was collected by Mr. Holzner, at Fort Huachuca, October 11, 1893.

¹ Van Denburgh, Proc. Cal. Acad. Sci., (2) VI, 1896, p. 342.

² Idem, VI, 1896, p. 344.

LAMPROPELTIS SPLENDIDA (Baird and Girard).

Ophibolus splendidus BAIRD, U. S. and Mex. Bound. Surv., II, Rept., p. 20, pl. xiv.

A fine specimen of this beautiful snake was obtained by Dr. Fisher at Babacomari Creek, on May 22. It is typical in every respect, having twenty-three scale rows and the very characteristic coloration of this form. Specimens have been recorded from Tucson,¹ from Fort Buchanan,² and from Fort Lowell.³ I have compared the above specimen with four specimens from southern New Mexico (U.S.N.M. Nos. 22373-22374, collected by Mr. Lane in the Mesilla Valley, and U.S.N.M. No. 1849, two specimens from Fort Filmore), and one from northern Texas (U.S.N.M. No. 1709, collected by Dr. Kennerly between the Pecos and the Rio Grande), and find them all alike and typical, with twenty-three scale rows. Neither can I discover any essential differences in a specimen from San Diego, extreme southern extension of Texas. This form, consequently, seems to skirt over Mexican border pretty closely. It probably extends some distance south into Mexico, how far we can only conjecture.

There seems to be no necessity, for the present at least, to burden this form with a trinomial. It is true that Western examples of what is usually called "*Ophibolus sayi*,"⁴ especially those from Arkansas and Indian Territory approach the color pattern of *L. splendida*, but in the first place it is only an "approach," and in the second place they retain the normal number of twenty-one scale rows characteristic of the form which we have just named *L. holbrookii*.

LAMPROPELTIS PYRRHOMELÆNA (Cope).

A very fine specimen collected by Dr. Fisher in the Huachuca Mountains at an altitude of 6,000 feet, on May 18, belongs to the typical, white-snouted form of this species.

This form, which is characterized by having the entire snout anterior to the frontal, including labials, pale yellow, by having the first black

¹ U. S. and Mex. Bound. Surv., II, Rept., p. 20.

² Cope, Proc. Phila. Acad., 1860, p. 255.

³ Van Denburgh, Proc. Cal. Acad. Sci., (2) VI, 1896, p. 347.

⁴ A new name must be given to Holbrook's *Coronella sayi*, and I propose to call it *Lampropeltis holbrookii*. The name was originally proposed by Holbrook under the misapprehension that it was the species previously described by Schlegel as *Coluber sayi*. Holbrook (N. Am. Herpet., 2 ed., III, p. 99) expressly calls the species "*Coronella sayi*—Schlegel;" in the synonymy he quotes "*Coluber sayi*, Schlegel. Phys. des Serp., tom. II, p. 157;" and at the end of the article (p. 101) he says: "Schlegel was the first naturalist who published a description of this beautiful animal, in his excellent work entitled 'Essai sur la Physionomie des Serpens.'" Schlegel's *Coluber sayi*, however, is an entirely different snake, viz, *Pituophis sayi*, and Holbrook's misapplication of the name given by Schlegel is consequently inadmissible for the present species. This principle is recognized by all codes of nomenclature, and I need not specifically quote the A. O. U. Code, Canon XXXIII.

cross band one to two scales behind the parietals, and by having a great number of yellow cross bars (varying from 37 to 57 from head to anus), has thus far been found in western and southern Arizona only. In California, from "northern California," whence came the type of Lockington's *Bellophis zonatus*, to San Diego, there occurs a different form with fewer yellow bands (30 to 42 on the back, in our specimens), and with the snout and labials black like the rest of the head. The first black cross bar is even a little closer to the parietals, sometimes touching them. This form is clearly entitled to subspecific rank and may be called *Lampropeltis pyrrhommelæna multicincta* (Yarrow).¹

In New Mexico and eastern Arizona we have again another form. In this the snout is black, as in the California subspecies, but the number of yellow cross bands on the back is still smaller (less than 30; 23 in our specimens) and the first black cross band is farther back, being removed from the parietals by three to five scales. This form needs a name and I propose for it *Lampropeltis pyrrhommelæna celænops*.²

It will be seen that I have ignored Blainville's name *Coluber zonatus*, which Boulenger, following Lockington's example, has recently revived for the present species. Blainville's description is very incomplete and differs, especially in the coloration, so much from any specimen I have seen that the identity of his snake with the present species appears very improbable. The type has been lost, as we are informed by Bocourt, and there seems no way of exactly determining to which species the name belongs. Under these circumstances I think it better to drop it altogether as unidentifiable with any known snake, especially since there is no proof that the type came from a locality in which the species here treated of has been obtained by later collectors.

The character by which Boulenger³ separates the present species from his *C. micropholis*, viz., "first black band on nape only" of the former as against "first black band forming a complete ring extending across the throat" of the latter,⁴ does not hold at all, since we have in the collection at least two California specimens in which the ring is complete, extending across the throat.

PITUOPHIS CATENIFER DESERTICOLA Stejneger.

Three specimens collected by Dr. Wilcox, one in the immediate vicinity of the fort, another at an altitude of 5,300 feet (Nos. 17791, 19675, 21105). There is also a specimen from Lieutenant Benson (No. 14744).

¹*Ophibolus getulus multicinctus* Yarrow, Proc. U. S. Nat. Mus., V, 1882, p. 440.

²*Type*.—U.S.N.M. No. 22375; locality, Mesilla Valley, New Mexico, H. B. Lane, coll.

³Cat. Snakes Brit. Mus., II, 1894, p. 190.

⁴In the synonymy of *Coronella micropholis* Boulenger curiously enough cites my *Lampropeltis annulatus* (Proc. U. S. Nat. Mus., XIV, 1891, p. 503) as against Kennicott's *L. annulata*, which he places under *C. gentilis*, in spite of the fact that my remarks are based upon and chiefly refer to Kennicott's type specimens.

SALVADORA HEXALEPIS (Cope).

Three specimens from Fort Huachuca, two young ones by Dr. Wilcox (Nos. 17792, 17793) from the immediate vicinity of the fort, and one by Dr. Fisher (No. 22201), collected April 28, 1892.

None of these specimens possess the subocular which gave rise to establishment of the name *hexalepis*, and which has been variously considered as characteristic of a subspecific form inhabiting the more western deserts.¹ Mr. van-Denburgh² has shown that this character is not constant enough to warrant the retention of a subspecific form thus restricted.

The use of the name *Salvadora hexalepis* for our specimens therefore requires an explanation. By a careful examination of a large number of specimens from Texas on the one side, and from Arizona and farther west on the other, I found that the former belong to the species called *Salvadora bairdi* by Jan, having all the essential characters of this form, hitherto attributed to Mexico only, remarking at the same time that these differences are those of scutellation, not of color, which is equally and similarly variable in both species. It now turns out, however, that Baird and Girard's type specimen of *Salvadora grahamiæ* belongs to the eastern species and that Jan's *S. bairdi* consequently is a pure synonym. The Arizona and California species therefore can not remain under the old name *S. grahamiæ*, but *S. hexalepis*, being based upon an Arizona specimen perfectly typical of the species, becomes available.

The synonymy of the two species would thus stand as follows:

SALVADORA GRAHAMIÆ Baird and Girard.

1853.—*Salvadora grahamiæ* BAIRD and GIRARD, Serp. N. Am., p. 104.

1860.—*Salvadora bairdi* JAN, Icon. Gén. Ophid., Pt. 1, pl. III, fig. 2.

SALVADORA HEXALEPIS (Cope).

1860.—*Salvadora grahami* JAN, Icon. Gén. Ophid., Pt. 1, pl. III, fig. 1 (not *S. grahamiæ* Baird and Girard).

1866.—*Phinothyra hexalepis* COPE, Proc. Phila. Acad. Nat. Sci., 1866, p. 304.

Most of the characters separating these two species are very well shown in the two figures of Jan quoted above.³ These differences are as follows:

In *S. grahamiæ* the frontal is comparatively longer and narrower behind; the parietals are also longer and comparatively narrower; the frontal is less wide and its edges not raised so much from the nasals; the first pair of infralabials is normal; and the second pair of chin shields are in contact or separated by at most one scale.

In *S. hexalepis* the frontal is shorter and broader; the parietals are

¹ See my notes in N. Am. Fauna, No. 7, 1893, pp. 205-206.

² Proc. Cal. Ac. Sci. (2), V, May 28, 1895, pp. 146-147.

³ Bocourt (Miss. Sc. Mex., III, Rept., pl. XLIII, figs. 2 and 3) figures what he considers *S. grahamiæ* and *bairdi*, but both specimens figured evidently belong to the same species, viz, *S. grahamiæ*.

also shortened; the rostral is very wide and its edges detached; first pair of infralabials are elongated very much posteriorly, forming an unusually long suture, while the mental is reduced to a minimum; the second pair of chin shields are separated by one or two pairs of scales.

In the material I have been going over at present I find no intergradation, and consequently adopt a binominal appellation for the two forms. As might be expected, one or the other of the characters pointed out above may be less pronounced in some specimens than in others, but they hold as well or better than in most other cases of nearly related species of snakes.

BASCANION FLAGELLUM FRENATUM Stejneger.

Four adult specimens perfectly characteristic of this form are in the collections from Fort Huachuca, two by Dr. Wilcox (Nos. 19676, 19677) and two by Dr. Fisher, May 27, 1892 (Nos. 22197, 22198).

BASCANION SEMILINEATUM Cope.

This species, which was only recently described, appears to be rather common among the trees and bushes in the Huachuca Mountains. Lieutenant Benson sent the Museum two very large specimens (Nos. 14745, 14716). Dr. Wilcox one (No. 19678), and Dr. Fisher one (No. 22200). Van Denburgh¹ also records one specimen collected by Price in the Huachuca Mountains, June 30, 1894. Dr. Fisher caught one (No. 22199) at Fort Bowie, Arizona, on May 21, 1894, swallowing a young Woodhouse's jay in the nest.

This very distinct and readily recognized species is excellently figured by Günther in the Reptile part of the *Biologia Centrali-Americana*.² In all our specimens, however, the posterior half of the frontal is much narrower than in the outline drawing of the head on the plate just cited.

RHINOCHEILUS LECONTEI Baird and Girard.

Two specimens from Fort Huachuca, by Dr. Wilcox (Nos. 2110, 2111).

THAMNOPHIS CYRTOPSIS Kennicott.

There are six specimens of this snake in the collection from Fort Huachuca, viz: Four by Dr. Wilcox (Nos. 17794, 17795, 19679, 21112), one by Dr. Mearns (No. 21060), and one by Dr. Fisher (No. 22205.) Two of Dr. Wilcox's specimens are from "the immediate vicinity of the post."

I have examined into the question of the alleged subspecies of the present species with some care. In the first place, it turns out that Cope's *ocellata*, from Helotes, Texas, is absolutely identical with Kennicott's type of *cyrtopsis* (U. S. Nat. Mus., No. 930, from Rinconada, Coahuila, Mexico; not Durango, Mexico, as alleged by Cope.)³ These specimens, it is true, differ from most other specimens in the collec-

¹Proc. Cal. Acad. Sci. (2), VI, Aug. 18, 1896, p. 347.

²Pl. XLVI, fig. A.

³Proc. U. S. Nat. Mus., XIV, 1891, p. 656.

tion by larger spots on the sides under the lateral line, by a horseshoe-shaped black mark on the sutures of the seventh supralabial and by the dorsal line not reaching the parietals, but there seem to be too many exceptions to make it expedient to recognize a subspecies based on these characters. Thus among the Huachuca specimens No. 22205 has the spots below the lateral line as heavy as the type of *cyrtopsis*, and the horseshoe mark is clearly indicated. Then, again, in the Coahuila specimens without this mark and the spots the dorsal line does not reach the parietals, while a specimen from San Antonio, Texas (No. 22387), has heavy spots, but no horseshoe, and the dorsal line reaches the parietals. With the present material, therefore, I am unable to recognize any subspecies of *T. cyrtopsis*.

TANTILLA WILCOXI, new species.

Diagnosis.—Eye more than half as long as the snout; frontal less than twice as broad as the posterior border of the supraocular; seven upper labials; two postoculars; frontal six-sided, anterior angle obtuse, posterior acute; ventrals about 150; two pairs of chin-shields, anterior pair longer than posterior; rostral much broader than deep; frontal once and a half as long as broad, longer than interparietal suture; first lower labials not in contact behind the mental; posterior nasal and preocular large, broadly in contact; a white collar two scales wide just behind the parietals and taking in their extreme posterior angle, followed by a narrow dark band only one and a half scales wide.

Habitat.—Southern Arizona.

Type.—No. 19674, U.S.N.M.; Fort Huachuca, Arizona; Dr. T. E. Wilcox, coll.

Description of the type.—Head broad, especially across the temples, much wider than neck; eye large, more than half as long as the snout, and nearly twice as large as its distance from the commissure; rostral much wider than high, the portion visible from above equals the internasal suture; internasals short, less than half as large as the prefrontals, the lower border of which is wedged in between posterior nasal and preocular, but not in contact with supralabials; frontal six-sided, the anterior angle obtuse, the posterior acute, the lateral sides converging backward, its width about two-thirds its length and less than twice the width of the supraoculars, its length equaling the interparietal suture, though slightly shorter than the parietals; supraoculars, rather larger, their width more than half that of the frontal; parietals as long as their distance from tip of snout; nasals and preocular of about equal size, the latter broadly in contact with posterior nasal; one preocular; two postoculars; temporals 1+1, long and narrow; supralabials 7, seventh very high, third low, fourth nearly twice as wide as third, both entering eye; infralabials 7, four in contact with anterior chin-shields, first pair not in contact with each other behind mental; anterior chin-shields very long, much longer than second; 15 rows

of smooth scales; three pairs of scales between posterior chin-shields and ventrals; ventrals 152; anal divided; 40 caudals (tail defective).

Color (in alcohol) very pale brownish gray, without stripes, lighter underneath; top of head dark brownish gray, the dark color barely encircling the eyes and descending broadly to the commissure at the suture between the sixth and seventh supralabials; a white semicollar just behind the parietals taking in their extreme posterior angle, two scales wide, followed by a dark-brownish gray band only one and a half scales wide.

Total length 184 mm.; tail (defective) 40 mm.

Remarks.—This new species, which I take pleasure in naming for its discoverer, Col. Timothy E. Wilcox, surgeon, U. S. A., seems to be more nearly related to *Tantilla melanocephala*, distributed in various forms through Central and South America, than to any of the other species hitherto found in the United States. It has the same wide head distinctly set off from the neck as well as the large eye, but the frontal appears to be longer, and the first pair of infralabials are separated by the mental. The coloration of the head is also very different, resembling as it does, superficially that of *T. coronata*. It is probably the same species to which Mr. van Denburgh refers under the name of *T. coronata*, a specimen collected by Mr. Price, also near Huachuca,¹ but the true *T. coronata* has a differently shaped head, more compressed and tapering in front of the eyes and less wide across the temples, much smaller eyes and smaller supraoculars. The coloration of the head is slightly different also, inasmuch as the dark collar is wider in the latter and the supralabials are dark colored in front of the eye, light behind.

Now that Günther has described Bocourt's Mexican *Homalocranion coronatum* as *H. bocourti*,² it seems probable that *T. coronata* does not occur in Mexico at all. It would then be interesting to know what is Garman's *T. coronata*, from San Luis Potosi.³

TRIMORPHODON LYROPHANES Cope.

A single specimen (No. 19673) was obtained at the fort by Dr. Wilcox in 1892. It has 22 scale rows and 9 supralabials.

This species has been taken in other places in southern Arizona, viz, by Henshaw (No. 8760) in October, 1874, and by Dr. Irwin at Fort Buchanan (No. 5283).

ELAPS EURYXANTHUS Kennicott.

Of this very interesting snake there is a specimen (No. 17790) from the immediate vicinity of the fort at Huachuca, collected by Dr. Wilcox, while Dr. Fisher's collection contains a specimen from Fort Bowie (No. 22194).

¹ Proc. Cal. Acad. Sci. (2), VI, August 18, 1896, p. 346.

² Biol. Centr.-Amer., Rept., p. 149.

³ Bull. Ess. Inst., XIX, 1887, p. 128.

SISTRURUS CATENATUS EDWARDSII (Baird and Girard).

A single specimen of the Western massasauga, collected by Dr. Wilcox on the parade ground of Fort Huachuca (No. 17789), is the only definite record of this species west of the Rio Grande, except a specimen collected by Henshaw in "southern Arizona" (No. 8409).

CROTALUS PRICEI Van Denburgh.

This rattlesnake, so distinct from all the other species occurring within the United States, was described in 1895 by Mr. van Denburgh from five specimens collected by Mr. W. W. Price in the Huachuca Mountains. Curiously enough, it has not been obtained by any of the parties collecting for the United States National Museum.

CROTALUS MOLOSSUS Baird and Girard.

Two highly colored specimens of this handsome rattler have been sent in by Dr. Wilcox, viz, Nos. 17788 and 21107. The first-mentioned one was taken in the canyon above the fort at an altitude of about 5,500 feet.

CROTALUS ATROX Baird and Girard.

Four specimens from Fort Huachuca, viz, two by Lieutenant Benson (Nos. 14742, 14743) and two by Dr. Wilcox (Nos. 21108, 21109), demonstrate most convincingly the utter unreliability of the so-called *C. scutulatus*. Benson's smaller specimen (No. 14742) has the scutellation on the anterior portion of the head of the typical *C. atrox*. No. 21109 has two enlarged scute-like scales between the anterior half of the supraoculars, preceded and followed by small scales; No. 21108 has similarly enlarged scales, which, however, are preceded by a pair just like them, and followed by another pair somewhat smaller; the fourth, a very large specimen, is somewhat intermediate between the three others, as it has two pairs of large scales between the supraoculars, separated on the median line, however, by a series of small scales, while the median space in front of the interoculars is covered with small scales.

This is a fair example of the status of this alleged species, not only in this locality but wherever it is found. It is nothing but an individual variation, more common in the Rocky Mountain and Sierra Madre region, perhaps, than elsewhere, but nowhere attaining such a percentage of stability as to warrant its recognition even as a subspecies or race.

CROTALUS LEPIDUS Kennicott.

Two specimens from Fort Huachuca have been sent in by Dr. Wilcox (Nos. 19672, 21106), one without head. This rare snake seems to be not uncommon in this region, as four specimens were collected by Mr. Price near Fort Lowell and in the Huachuca Mountains.¹

¹Van Denburgh, Proc. Cal. Acad. Sci., (2), VI, 189 6, p. 348.

CONTRIBUTIONS TOWARD A MONOGRAPH OF THE LEPIDOPTEROUS FAMILY NOCTUIDÆ OF BOREAL NORTH AMERICA.

A REVISION OF THE MOTHS REFERRED TO THE GENUS LEUCANIA, WITH DESCRIPTIONS OF NEW SPECIES

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As it stands in our lists at present the genus *Leucania* includes all those species with hairy eyes and unarmed legs in which the vestiture is more or less hairy, the colors pale yellow or luteous tending to reddish, and the markings more or less strigate; normal noctuid maculation rarely complete. The antennæ of the male are simple or nearly so and the front of the head is without modification.

Setting aside a small series of narrow-winged, long-bodied forms as generically distinct under the name *Neleucania*, the remainder of the species agree in the somewhat robust body, moderate, not retracted head, long and functional tongue. The eyes are round, moderate in size, and the palpi reach the middle of front. These palpi are stout, hairy, the terminal joints short and obtuse. *Pilipalpis* is an exception, chiefly in the male. The thorax is usually quadrate, with collar and patagiæ fairly well marked; but in some series it is quite loosely clothed, with the parts undefined. The vestiture varies from thin hair, through flattened hair to a mixture of long scales and hair; the latter an unusual feature. Behind the collar centrally there may be a small ridge or crest, a small divided crest, or no obvious tufting at all.

The abdomen is untufted except at sides in the males. The vestiture on the under side is loose and woolly, the males being apt to have the legs sexually tufted.

The primaries vary somewhat in shape and may be quite stumpy or trigonate with marked or even acute apices.

The species occur throughout the United States and north as well as southward, though on the whole the genus may be said to be Northern rather than otherwise.

In the preparation of this paper my reliance has been first of all on the material in my own hands, which was more complete than that of

any other single collection. From the United States National Museum I had 100 examples, including all save type specimens. From Dr. William Barnes, of Decatur, Illinois, I had his entire material in the genus, peculiarly rich in some local Western forms. From Mr. W. D. Kearfott, of Montclair, New Jersey, I had a series of specimens illustrating a few special forms. The collections of the American Museum of Natural History were carefully compared and some undetermined material was loaned. The collection of the Brooklyn Institute of Arts and Sciences (Neumoegen and Graef collections) was compared and specimens were loaned from it. From the collection of the American Entomological Society several specimens were secured. The Strecker material was carefully compared, and in addition, several correspondents sent me examples that will be specifically acknowledged later on.

Within the limits of the genus proper the species range themselves into a number of small or larger groups, some well, some ill defined, and in one or two cases not altogether easily separated on other than sexual characters. It might be put in a somewhat different way as a number of well-marked species, some of which remained true to type, others of which diverged and gave rise to forms which are not yet altogether well marked.

A somewhat well-defined series may be typified by *unipuncta*, in which there is a sharp ridge or crest behind the collar, not very prominent to be sure, but always recognizable in good examples. As additional characters we have the trigonate, pointed primaries in which both the ordinary spots are at least traceable, and the character of the male genitalia.

The group consists of only two, very unlike species, one of which is known in the female only.

Lutina differs from all our other species in that it has both the ordinary spots outlined by yellowish rings, the median lines complete, and the subterminal line obvious. In other words, the normal noctuid maculation is complete. The only example known to me is from Florida and is a female.

Unipuncta has the ordinary spots on the primaries paler, but not ringed, so that they are obvious, but not defined. The median lines are punctiform, and in some specimens both are completely traceable. Usually, however, the transverse anterior line is lost in the general powdery character of the wing, and sometimes the transverse posterior line shares the same fate. The general color is a variable shade of reddish or fawn gray or brown, sometimes with a little admixture of yellowish. The surface is speckled with black, forming a dark oblique subapical shade and a dusky shading along the median vein, at the end of which is a single white dot.

The secondary characters of the male consist of moderate fringes on

all the femora inferiorly, and with outward fringes of long hair on the tibiæ, forming no tufts in either case; but those on the middle pair more prominent than any of the others. In the antennæ there is a longer bristle on each side of each joint.

The male genitalia are unique and rather simple. The harpes are somewhat narrow at base and, at a little less than half their length, divide into a broad inferior lobe and a narrow superior continuation, which again enlarges into a broad rounded tip, the inner surface of which is set with short, stiff, pointed spines. The clasper is a small, curved claw or beak at the point where the harpes divide.

In all the other species there is either no obvious tufting of any kind behind the collar or there is a small divided crest.

In the group *pseudargyria* we have two species with robust bodies and comparatively short, obtuse primaries, in which both the ordinary spots are marked and the transverse posterior line is composed of a double series of venular dots. Both are reddish luteous in color and are more or less black powdered.

Pseudargyria has the abdomen conspicuously tufted in the male, and the genitalia have dense hair and scale tuftings. The legs in the same sex are very prominently tufted, the most conspicuous clothing being on the anterior pair. The coxa has a tuft of long, curly scales on the outside. The femur has a bunch of thick blackish hair inferiorly, longest toward the tibia, capable of brush-like expansion. The tibia has a dense covering of black hair capable of fan-like expansion exteriorly—altogether a very striking modification. The middle leg is rather shorter and stouter than usual; femur with a fringing of long hair inferiorly; tibia set with long hair on all sides so as to form a prominent loose brush, not capable of fan-like expansion. In the posterior leg the femur is fringed with long hair inferiorly, but not so much as on the others; the tibia with a clothing of thin hair on all sides, not forming an obvious brush.

The genitalia resemble those of the group *commoides*. The harpes are very broad at base and narrow only a little inferiorly for nearly two-thirds their length, then they are cut off abruptly from below to form a narrow, oblong, obliquely rounded tip. This oblique tip is set with long, rather stout bristles. At the point on the upper margin where the oblong tip joins the broad body of the harpe there is a curved elevated ridge with the margins turned in, forming a crater-like cavity with the outline incomplete. The clasper is a moderately long and stout cylindrical hook, not much curved, arising from the inner portion of the crater over a broad, irregular, corneous plate.

The species occurs east of the Rocky Mountains throughout the greater portion of the United States and Canada.

Pilipalpis is obviously related to the preceding in appearance, but has a prominent diffusely margined black shading from the reniform

to the transverse posterior line. I have only a female at hand, but Mr. Grote's type was a male. He compares it with *pseudargyria*, states that it does not have the exaggerated tufts on abdomen and tibiae, and adds that it has "a curious fan-shaped tuft of spreading hair arising from the upper surface of the second joint of the unusually prominent palpi."

This character is distinctive and will serve to differentiate the male from all others of our species. The female is readily recognizable by the blackish shade already described. All the known specimens are from Florida.

Subpunctata stands by itself, but in many points resembles *unipuncta*. It is decidedly smaller, has somewhat narrower primaries, but of the same shape, and has the dark shading over the median vein, relieved by a single white dot at the end of the cell.

In other respects the type of maculation is the same, but the color in *subpunctata* is darker and it is closely *strigate* with blackish on the veins and in the interspaces. The secondaries are white at base, semi-translucent, with a smoky outer border. Behind the collar is a distinct divided thoracic crest, and this separates the species sharply from *unipuncta*.

In the male the anterior legs have a fringe of black scaly hair on the coxæ; the femora have a dense fringe of shorter scales; the tibial vestiture is short, dense, and not prominent. On the middle leg the femora have a moderate fringe of not very long hair; the tibiae are set with moderate hair on all sides, but it is neither very dense nor brush-like. On the posterior leg the femora have a moderate fringe basally and the tibiae have thin, scant, longer hair.

The male genitalia are characteristic. The harpes are very broad basally and beyond the middle narrow abruptly and evenly from both margins to about one-fourth their previous width; beyond that they broaden gradually to a slightly rounded tip which is furnished with a series of six long bristle-like hairs set in conspicuous pits. The clasper is an irregular corneous plate from which arises a short, cylindrical, nearly straight spur and two lower, somewhat curved, pointed processes; quite unique in the genus.

Dr. Strecker's species *complicata* is a small example of this species, whose home is in Texas and New Mexico.

Pallens is typical of a rather well-defined group in which the vestiture is thin and hairy, forming no obvious tufting on the thorax and leaving the collar and patagiae not or but feebly defined. There are no lines or other marks on the collar and none on the thorax. The primaries are normally trigonate, with marked but not acute apices, without longitudinal dark lines or obvious discal spots, the median vein whitish, rarely well marked, and the transverse posterior line wanting or reduced to two black dots. The secondaries tend to

blackish on the disk, leaving the margins white. In the male, the leg tuftings are not prominent, the femora fringed inferiorly and one or more pairs of tibiae with longer hair, forming no tufts. The male antennae have single, slightly longer lateral bristles on each joint.

The male genitalia are quite characteristic, and all the species resemble each other closely in this particular. The harpes are broad at base and broaden to the middle, where they are suddenly narrowed from below, the upper margin being continuous. Beyond this they broaden again into a rounded, lappet-like tip, the inner side of which is closely set with pointed spines of moderate length. The clasper consists of two processes from the same base; one is cylindrical curved upward, hook-like, with an obtuse tip; the other is bent outward and curved downward, rather beak-like in character, the tip usually obtuse.

While the group itself is thus well defined and rather sharply separated from the others, the species within the group are very closely allied.

In the first place, comparing all accessible examples of the true European *pallens*, I do not find any American examples that entirely agree with any of them. The American examples, which I term *luteopallens*, are uniformly less strigate, uniformly brighter, and, on the whole, with whiter secondaries. There is quite a marked difference in the genitalia, comparing five pairs of the American with three pairs of the European form. In the latter the harpes are quite prominently angulate on the superior margin and the upper angle of the tip is quite obviously marked. The spinulation of the inner side is also less abundant and shorter. The lower clasper is broader and more spatulate in form than any American specimen. The alliance is close, but as species go in this group *luteopallens* is not the same as *pallens*.

The femoral fringes of the male are very moderate and the hind tibiae only have a little longer hair fringing above the middle. In this respect *pallens* agrees with *luteopallens*, which inhabits the Atlantic coast region.

Minorata is smaller and darker throughout, the secondaries in particular being blacker on the disk. The primaries have a broader, more stumpy appearance, due to the comparatively stouter body. In reality *minorata* is much more closely allied in appearance to *pallens* than is *luteopallens*; and this is also marked in the male genitalia, which are intermediate between those of *pallens* and *luteopallens*, while really distinct from both. The leg tuftings are much better developed, however, than in *luteopallens*, especially on the anterior and posterior tibiae, which have an obvious fringing of long hair.

This species ranges along the Rocky Mountain region from New Mexico northward into British America and to the Pacific coast at Vancouver.

Oxygale is somewhat larger and broader winged than the previous species, and has a grayish shading over the luteous base. The streakings are very fine and not contrasting, giving the whole insect a very even appearance. The secondaries are entirely blackish except along the costa, or there is only a narrow whitish edging along the outer margin.

The male genitalia are exactly as in *luteopallens*, but the leg tuftings are even more marked than in *minorata*. In this species the middle tibiae also are furnished with fringes outwardly, so that all are now fringed. The range of this species is from the middle Rockies southward, west to the Pacific coast, and throughout California.

Rubripallens differs from all the other species in this group by the reddish shading over the primaries. This is given by the reddish streakings over the yellow base, the paler veins being thereby more than usually relieved. The secondaries have a yellowish tinge and vary from this to a transparent smoky, the disk being always more or less blackish. The range of this species is from the middle Rockies into Utah.

The genitalia of the male do not differ from those of *luteopallens* and the leg tuftings are very like those of *oxygale*.

Pertracta Morrison belongs in this series, but I doubt its being an American insect. The type is in the Strecker collection, and, while the wings are perfect, the body is crushed as though it might have been papered. The locality given on the label is "Pennsylvania," and I have understood Dr. Strecker to say it came from a Philadelphia collector, whose name he did not give. I believe it to be an unusually well-marked *pallens*, with a reddish tint, a little discolored in the relaxing jar; in other words, a European specimen. Mr. Morrison was in several cases misled as to the source of his specimens, and I believe that in this case Dr. Strecker was also imposed upon. I can scarcely credit the occurrence near Philadelphia of a good species so like *pallens* and so rare that in twenty-six years not a specimen has been captured by any of the Philadelphia collectors.

In tabular form the species of this group may be separated as follows:

Light creamy yellow, streakings not contrasting; secondaries with a small discal area blackish	<i>luteopallens</i> .
Darker, with a luteous tinge; streakings more obvious and somewhat contrasting; secondaries with more of disk blackish	<i>minorata</i> .
Pale grayish luteous; streakings not contrasting; secondaries all blackish except the margins	<i>oxygale</i> .
Reddish luteous, obviously streaky; secondaries with a yellowish tinge, smoky or blackish shaded	<i>rubripallens</i> .

The group *albilinea* comprises another series of closely allied species which may be separated out with a little care and a fair material to work with. Superficially all the species agree in having the lower

half of the collar white, or at least much paler than the upper portion, and, in good examples, white lines on the patagiæ. The wings are normally trigonate, of moderate length, the apices well marked, though scarcely acute. The median vein is white, and the white streak tends to continue in the interspace between veins 3 and 4. Below this white shade is a more or less diffuse red, smoky, or blackish shade which extends to the end of the median vein. Above vein 4 from its inception a red, smoky, or blackish triangular shade extends, starting as a point and broadening outwardly until, on the outer margin, it fills the space between vein 4 and just below the apex, where it again ends in a point.

These characters of maculation are quite obvious and are easily recognizable; but the male genitalic characters are equally strong and equally distinctive. The harpes are moderately broad at base, oblong to a point well beyond the middle, and there abruptly narrowed from below. The narrow extension from the upper margin is obtusely bent downward and then suddenly enlarged into a hatchet-shaped tip; the outer edge with a fringe of spinules directed inwardly. This is characteristic of the group, and occurs nowhere else in the genus. The clasper is usually divided into three processes, of which the lower is more or less spatulate or ligulate; the upper flattened or round, shorter and stouter; the median is a longer, more slender, usually pointed spur. The upper and lower processes are from the same base, the central structure arises separately.

As to leg structure, in the males the species as a whole agree in having long, thin, hairy fringes on the under side of all the femora. The anterior tibiæ are variably fringed outwardly and the tufting is obvious. The median tibiæ are not obviously tufted. The posterior tibiæ are variably furnished with long thin hair, tending to real tufts. Generally speaking, the northern forms are not so obviously tufted as are the southern species.

The male antennæ are barely ciliate and do not have longer lateral bristles on the joints.

Rubripennis differs from all others in this series and in the genus by having all the darker shadings bright, pinkish red. The male genitalia while after the group type have the claspers quite different from those of any other species. The lower process is long, cylindrical, and pointed; the upper a broad, short beak.

The home of this species is in Texas, but it extends northward into Missouri.

Albilinia has dark smoky or black secondaries in both sexes, which may be a little lighter at the extreme base only. It is on the whole a small species, the primaries dark luteous in ground and the smoky shades broad and diffuse. The discal dots may or may not be prominent.

The male genitalia are of the characteristic form, with all the processes well developed.

This form has a wide distribution, ranging in my material from southern Arizona to New Jersey.

Obscurior resembles the preceding in size and in the dark color of the primaries; but the maculation is more even and the discal spots are absent. The secondaries are whitish to the middle or beyond, the margin diffusely smoky.

The genital structure is like the preceding and the form may be only a local variety. But it comes from Manitoba, and I have found this faunal region so well marked that I risk the name, based chiefly on the more even color of the primaries and the partially white secondaries.

Diffusa is a markedly lighter colored and larger species, the secondaries white, with a diffuse smoky outer margin varying in width. The dark areas of the primaries are much smaller and much better defined, the terminal space tending to become leaden gray. There is no difficulty at all in separating out this form from both of the preceding.

The male genitalia are distinctive chiefly by having the superior process short, blunt, and cylindrical, like a thumb, while the lower process is quite flattened. There are other differences in detail which may be better understood by a reference to the figures herewith given.

This is the most widely distributed form, Walker's type, coming from Nova Scotia, while Mr. Druce figures a specimen as coming from near the City of Mexico.

The other species in this group agree in having the secondaries entirely white.

Limitata is from Texas and has the brown shading to the white median vein on both sides of it—that is, there is a narrow brown shading that begins near the base of the cell itself, margins the vein on each side, and, beyond it, continues into the brown subapical shade.

The male genitalia have the superior process flat and squarely terminated, the inferior more obviously spoon-shaped than in the other species.

Tetera differs from the preceding in that the median vein is not obviously whitish, and there is no dusky shade above the median vein. The dusky shadings are well marked, but a pinkish shading is introduced along the costa and in the submedian interspace. The discal spot is marked in all the specimens, and is also present in the preceding species.

In the male genitalia the species is the most aberrant of the group. The upper process of clasper is altogether lacking; the lower process is cylindrical, finger-like, and the middle hook is only moderate in length, a little curved and pointed at tip. The tip of the harpes is

also quite different from the allied forms, and altogether this proves itself a good species without doubt. It is from Arizona.

Neptis resembles *diffusa*, but the secondaries are entirely white, the dark shadings on the primaries are much reduced, much more even, and the discal spot is absent in most cases.

The genitalia are practically like those of *diffusa*, but the lower process of clasper is a little more scoop-shaped at tip, and the tip of the harpe is somewhat more narrow and pointed. Otherwise in all respects the resemblance is very close. All the specimens are from Colorado.

Taken together the species recognized here make an unusually compact group, from which *rubripennis* stands out at once by its red color. *Albilinea* and *obscurior* are small, very dark species in which the secondaries are smoky or pale only at base. The latter may easily be a local variety of the former.

Diffusa is larger and paler, with the secondaries white except for the smoky dusky margin, which varies greatly, and *neptis* may be a local variety in which the smoky tinge disappears altogether.

Limitata is a good species with white secondaries, in which the median vein is margined on the upper edge.

Tetera is well marked by genital structure and by the tendency to pink tinging in the costal and submedian regions of the primary.

In tabular form the differences appear as follows:

- | | |
|---|----------------------|
| 1. Primaries with the darker shadings pinkish red..... | <i>rubripennis</i> . |
| Primaries with the darker shading smoky or blackish | 2 |
| 2. Secondaries white at base, smoky toward and at outer margin | 3 |
| Secondaries white | 4 |
| Secondaries black | <i>albilinea</i> . |
| 3. Size small, colors dark, secondaries translucent at base, smoky margin broad. | <i>obscurior</i> . |
| Size larger, colors much lighter; secondaries white except for a smoky outer margin, which is narrow or very narrow | <i>diffusa</i> . |
| 4. Median vein white, with a brown margin on each side..... | <i>limitata</i> . |
| Median vein not obviously white, without dusky margin above | 5 |
| 5. Discal dot obvious; a pinkish shading on costa and in submedian interspace .. | <i>tetera</i> . |
| Discal dot wanting or obscure; shadings reduced, even, not pinkish | <i>neptis</i> . |

The group *ligata* is composed of three very closely allied species, which agree in rather small size, somewhat frail body, close, somewhat scaly vestiture, and a slightly convex thorax, in which the collar and patagiæ are not well marked. The collar has a single transverse line across the middle.

The primaries have the costa and inner margin convex, the outer margin oblique and somewhat rounded. A dusky median shade extends from base to outer margin over the median vein, which is partly white. This, with the small size and rather slight form, makes the characteristic feature in the species. The transverse posterior

line is punctiform and, in general, is complete or at least completely traceable.

Ligata has a distinct pinkish shading, and the surface is obviously black powdered. The markings are rather well defined and the transverse posterior line is generally complete. The species is from the South and Southwest.

Flabilis is exactly like *ligata* except that the pinkish tinge is less obvious and the punctate transverse posterior line is not quite so well marked. It is from Long Island.

Rimosa is *ligata* with all the markings more obscure.

It is more than probable that all these are slight local varieties of one species which is not uncommon southwardly, but becomes very rare as we go north. Of *rimosa*, Dr. Thaxter was good enough to send me a male, which he compared with the type in his possession, and besides these two examples I know of none in collections. Years ago Mr. Tepper took two examples on Long Island, which formed the types of *flabilis*. One of these is now in the British Museum and one is at the agricultural college in Michigan. I have an example compared with the British Museum type, and, by the courtesy of Prof. R. W. Pettit, I was able to compare the other type as well. There are no other specimens known to me as *flabilis* in collections.

The male genitalia are exactly alike in all three forms. The harpes consist of a broad, oblong basal piece from which a narrow oblong process, rounded at tip, extends superiorly. The inferior angle of this broad basal piece is drawn out into a sharp point. At the rounded tip there are two long, spine-like hairs, but no other armature. At the extreme base of each harpe is a long, stout, somewhat curved, and irregularly toothed chitinous process. The clasper forms one slender, cylindrical superior finger and two stouter, more beak-like, parallel, pointed processes.

The leg tuftings in the male show no strongly marked characters, the femoral tuftings and fringings being scarcely more obvious than in the female. The antennal ciliations, however, are well marked. It is scarcely needful to attempt the separation of these forms by means of a table.

The group *insucta* is composed of species with short, stumpy wings, robust body, the thorax quadrate, with a divided crest behind the collar, the latter being well marked and with transverse darker lines. The patagiæ are also well defined and a little uplifted. The vestiture is coarse and the species have a roughly powdered appearance, due to a speckling of black. The ground color is a dull grayish luteous with a tendency to reddish which is dominant in *insucta*. The primaries have a streaky appearance, the veins being usually lighter than the margins and in the interspaces a dusky streak is usually obvious. The median vein is usually white or at least paler, but there is no well-

defined dusky shade accompanying it inferiorly. There may be a dark or black basal streak, but this extends into the interspace and not along the vein. There is no black discal dot, though in some examples a few black scales help to define the white dot inwardly. The punctiform transverse posterior line is complete and sometimes tends to become geminate.

The legs in the males of this group have the sexual tuftings best developed in *heterodoxa*. The anterior femora are fringed beneath with long dense hair, about as long at base as at tip, and forming no tufts; the tibiae are not modified. The middle femora are fringed for their entire length, but the hair at base is very much longer than that at tip; the tibiae are outwardly clothed with very dense hair, thickest at the middle, but forming no expansible tufts. The posterior femora have a thin, moderate fringing at base only; the tibiae have a small fringing of hair outwardly.

In *dia* the development is about the same; in *insucta* it is not quite so well marked, and in *megadia* it is so reduced that there is not much difference between the sexes.

The genital structure is similar in type in all the species; but no two are quite alike. The harpes at about the middle are suddenly constricted from below and continued along the superior margin into a more or less long-oval tip. There may be one, two, or half a dozen long bristle-like hairs at the edges of this tip. The clasper is made up of two parts; a flat long plate, the margins rolled over on the upper edge, and at tip the upper angle is drawn out into a sharp curved hook. From this plate arises a long, cylindrical finger-like process directed obliquely upward and outward and extending well beyond the upper margin of the harpes.

Only in *dia* are the lateral bristles of the male antennae in the least marked.

Dia is the smallest of the species, the veins all white marked and no obvious black markings anywhere in the wing. The species is from California.

Megadia is somewhat larger, much better marked, the dark shadings obvious; a black or blackish curved basal streak extending into the submedian interspace. It extends along the mountain ranges from Arizona into British America.

Heterodoxa is again larger, markings fully as obvious as in the preceding; but there is no curved basal dash and the punctiform transverse posterior line is more obvious. The male genitalia also show an obvious difference as compared with those of the preceding two forms and resemble more nearly the following. It extends throughout the northern United States to the Pacific coast.

Insucta is perhaps a little larger on an average than *heterodoxa*, and decidedly reddish in color, varying somewhat, however, on this point.

The streakings are more prominent than usual and, altogether, it has all the group characters better and more completely developed than any other species. The black basal streak is obvious in this species.

In tabular form the species separate readily, as follows:

Primaries without a basal black streak.

Size small, all the markings obscure; veins white, not obviously relieved by darker streakings; secondaries whitish, even *dia*

Size larger, all the markings obvious; veins relieved by definite streakings; secondaries outwardly blackish or smoky, not even *heterodoxa*

Primaries with an obvious curved black or blackish basal streak.

Size small, primaries more obtuse; color luteous dull gray, rarely shaded with red *megadica*

Size large, primaries a little more pointed; color reddish gray, shading into brick red *insueta*

The species *extincta* is entitled to rank as a group by itself because of its rather narrow primaries which are acute at the apex, a little incurved below, and form an obvious obtuse angle below the middle of the wing. The thoracic vestiture is rather fine and thin, forming no obvious tufts and relieving neither collar nor patagiæ; the collar is crossed by two transverse lines. The primaries are very obviously streaky, while the lines are not contrasting; there is a white point relieved by a few black scales at the end of the median vein and the transverse posterior line is bent very strongly inward below the middle.

In some respects the species resembles the *ligata* group, but the wing form differs materially and the sexual characters are more nearly like *phragmatidicola* through *juncicola*.

The leg tuftings in the male are not well developed. There is the usual fringing on the femora, much reduced and a little thickening of the vestiture on the middle tibia; nothing like a well-developed tuft.

The genitalia of the male consist of very broad, irregularly oval harpes from the upper margin of which very narrow tips extend. The end of each tip is somewhat rounded and set with long, slender, bristle-like hair. The clasper consists of a broad chitinous plate from the upper angle of which come two curved corneous processes. One of these is cylindrical, hook-like, and extends downward; the other is beak-like and is directed upward, extending beyond the upper margin.

The male antennæ have single longer bristles laterally on each joint.

The species is not easily mistaken and occurs along the Atlantic coast to Maine.

Leucania juncicola also stands by itself on genital characters, but superficially it resembles the group *phragmatidicola* very closely. The body is robust, thorax quadrate, collar and patagiæ well marked. The collar has a series of transverse lines of different colors, culminating in a broad purplish band below a narrow whitish tip; the band made up of three narrow lines of black, blue, and brown. The little tuft

behind the collar is also purplish. Transverse posterior line punctiform usually reduced to two dots only; a black dot in the submedian interspace. Secondaries more or less smoky.

L. multilinea of the next group resembles *juncicola* quite nearly, but has white secondaries and a less prominently lined collar. It also lacks the black dot in the submedian interspace, hence the differentiation is easily made when the two are at hand together. In the male the prominent tuftings of *multilinea* are at once distinctive. All the specimens of *juncicola* seen are from Texas or Florida.

The leg tuftings of the male are not especially marked. The femoral fringes are much as described for the group *insueta*, but are not so long or so well developed. The tibial tuftings are obvious, but not prominent; also like *insueta* in general type.

The male genitalia are unique. The harpes are very broad, almost triangular in shape, the angles broadly rounded, the upper outer margin prolonged into a narrow, parallel process, rounded at tip. At the point of junction with the basal portion is an elevated slightly rounded ridge, toothed at the edges. The narrow process is closely set at tip and along its inferior margin with long bristle-like hair arising from definite pits. The claspers arise from the upper outer angle of a broad chitinous plate; one of them is beak-like and curves down, almost parallel with the edge of the plate; the other is a slender cylindrical process a little enlarged above the middle.

The male antennæ are practically simple.

The group *phragmatidicola* consists of yellow or reddish luteous species with moderately elongate trigonate primaries in which the apices are at least well marked if not pointed. The body is quite robust, collar and patagiæ well marked, and in good specimen an obvious little divided crest anteriorly. The collar has one, two, or even three transverse lines, but these do not culminate in a purplish band. In the type form the median vein is white, margined with a black or dusky shading; there is a triangular dusky shade based on vein four, extending nearly to the apex, and this is traceable in all save the palest forms.

The leg tuftings in the male are so variably developed that it is deemed best to refer to them under specific headings.

The primary sexual characters of the male are distinctive; very similar for the species as a whole, yet with plenty of difference in detail, easily determinable by a comparison of the figures herewith given.

The harpes are broad at base, narrowing a little on the inferior margin until, at about two-thirds from base, they are abruptly cut so as to form a trigonate lappet, continuous on the upper margin. On the lower margin and at tip are a series of long, stiff hairs set into pits. At the junction of this outer narrow process is a disk-like, semicircular plate with incurved edges, which seems perforated with a varying num-

ber of openings, no two species being quite alike. Then there is a broad chitinous plate from the upper outer angle of which come two processes. One is long, curved, beak-like, pointed at tip, and extends downward; the other is short, cylindrical, and extends upward over the base of the first. Sometimes a third process comes from the lower outer angle of the plate and sometimes the inner inferior angle is obtusely extended. In some species a flattened process extends over the chitinous plate from the thickened upper margin, and this may or may not be perforated.

The species of this series are not difficult to separate if both sexes are at hand. A male can be placed without difficulty at all times, and a good female may be generally determined by the tables so nearly as to make identification easy from the descriptions.

Two main, though unequal, divisions may be based on maculation, though they are not entirely natural. In the majority of the species the median vein on the primaries is white, in whole or in part, and along this vein, above or below, or on both sides, is a black or smoky line or shade extending to at least the end of the cell. While this character is very unequally developed, it is at least obvious in every reasonably good example, and separates the species possessing it from the smaller series, in which, while the vein may be white, or at least pale, there is no defining shade or line. Such species as lack the defining shade have no obvious maculation of any kind and are almost uniform, except for the slight differences between the interspaceal streakings and the veins.

In the first series *multilinea* stands alone, because in the male the anterior tibiae are most heavily tufted with dense masses of discolored hair and scales capable of expansion. The antennae also, in this sex, have longer lateral cilia than in any other species. It is a medium-sized or small form, the primaries light yellow, prominently streaked in the interspaces, and the collar white, distinctly banded. The secondaries are white, scarcely soiled even in the female. The transverse posterior line is usually reduced to two small black dots, and this, in combination with the white secondaries, prominent streakings, and small size, will differentiate the species even in the female.

In all the other species of this group, as well in the second as in the first division, the middle leg is the one most obviously tufted in the male. But this character varies greatly, and in a few instances there is only a marked thickening of the vestiture, rather than a brush or tuft.

Commoides and *phragmatidicola* have the sexual tuftings most prominent, and, in addition to the dense mass of vestiture on the middle tibia, that member is somewhat shortened and the outer spur is flattened and curved, the tip acute.

Commoides is a very stout, reddish-streaked form, with smoky-brown secondaries, and this differentiates the species at once from

all others in the series. The streak margining the pale median vein is black, there are black streaks along the inner margin and outwardly, and the streakings between the veins tend to become black. The sexual tuftings tend to become discolored, and the harpes of the genitalia are densely clothed on the outside with long yellow hair intermixed with broadly flattened scales. This prominent mass of vestiture can be somewhat expanded, but seems to form no real tufts or brushes of hair. There is at least one pair of longer pencils between the claspers at the base of the uncus, and these are probably capable of fan-like expansion. The species occurs throughout the eastern United States and Canada to New Mexico.

Phragmatidicola is altogether different in appearance and varies much more. It has a wide distribution and the variations are somewhat local. The primaries are narrower, more trigonate, and the apices more pointed than before. The ground color is pale luteous and the streakings are reddish between the light or dark veins. The dusky shading over the median vein may be smoky or blackish, and as a rule both sides of the vein are margined. The series of punctiform spots marking the transverse posterior line is usually complete though never very prominent, and there is usually a lighter shade through the cell and obliquely to the apex.

The sexual tuftings are very much as in *commoides* but less discolored and somewhat less prominent. The secondaries are white, tending to become a little smoky on the veins and outwardly. The species occurs from the Atlantic to the Pacific and from Canada to Florida.

In all the other species of this series the outer spur on the middle tibia of the male is cylindrical, straight, pointed at the tip and either short or very short.

Imperfecta stands by itself because of its dark smoky gray color, which is neither powdery nor obviously strigate. It has somewhat the appearance of an undersized, dark *unipuncta* with the powderings out, and this is emphasized by the fact that the black or blackish longitudinal shading covers the median vein almost to the end of the cell; leaving only a short, white, angular spur to emphasize the usual black point. The secondaries are whitish, with a tendency to smoky margins. The sexual tuftings are not prominent and the antennal ciliations are small, not longer toward the tip.

The species has been thus far received from Arizona only.

Anteroclara resembles *phragmatidicola* in appearance very closely. With males for comparison there can be no difficulty, of course; but there is a real difference in superficial characters, though it is difficult to locate in one word. As a whole, the species is a little larger, a little broader winged, with somewhat less pointed primaries. It is more yellow in color, less streaky in appearance, the black dot at the end of the median vein often wanting, never prominent, transverse pos-

terior line reduced to two small interspaceal dots, and the upper margin of the pale median vein not in any way relieved. The secondaries, especially in the female, have a smoky appearance, and altogether this seems a duller, more even species than its ally. Besides the difference in the tibial spurs, the sexual leg tuftings of the male are much reduced in *anteroclara* and the anal tuftings are not at all prominent. The specimens are from Calgary, Vancouver, and the Northwestern United States.

Calgariana is like *phragmatidicola* in size and appearance, except that the color is very decidedly reddish. The white median vein stands out in strong contrast, and in most of the specimens the black margining shade is very distinct. From *phragmatidicola* the sexual characters separate this species; from *anteroclara* the narrower, more pointed primaries and the color serve as distinctive characters. The secondaries are white in both sexes, the female only with a little fuliginous shading and somewhat smoky veins.

Thus far the species has been received from Calgary only.

Stolata is altogether different in appearance. The secondaries are snowy white, opaque, and the primaries are straw yellow. The white median vein is well marked, as is the dark shading beneath and beyond it between veins 4 and 5.

Only the female, from "Arizona," is at hand at present.

Oregona is like a very small *phragmatidicola*, more grayish red in color and with semitransparent white secondaries, in which the veins are hardly darker, and there is only a narrow smoky border at the base of the fringes. The secondary sexual characters are much reduced in all respects. The only locality, thus far, is Corvallis, Oregon.

With *roscola* begins a small group of species in which the median vein of the primaries, though it may be white or paler, is not margined or accompanied by any dusky shading. In fact, the wings are practically uniform except for the slightly darker interspaceal streakings which are characteristic of the genus. The shadings, which are so well defined in the typical species of this series, are here reduced to vague, dusky clouds, whose location must be understood that they may be recognized. In all of them the secondaries are white, the veins hardly darkened except in the female, in which, also, there may be a slightly dusky tinge.

Roscola, as its name implies, is reddish in tint. It is like *calgariana* with all the contrasts out; but is somewhat larger and seems broader-winged than that species. It was originally regarded as a color variety of *farcta*, and has all the characters, except color, of that species. It seems to be not uncommon in the Northern Pacific States and in British Columbia.

Farcta is pale creamy yellow where the preceding is reddish, and is even larger in size. It is *anteroclara* with all the dark shadings out

and the secondaries white. The sexual tuftings are very moderately developed and nowhere prominent. All examples thus far seen are from middle and southern California.

Palliseca is decidedly smaller, with narrower, more pointed wings, the primaries having lost almost all trace of maculation. The species occurs in the mountains of Colorado and in southern California; probably in the intermediate region as well.

In tabular form the species may be arranged as follows:

1. Median vein white or pale, accompanied by a black or darker shade more or less prominent, but always obvious..... 2
 Median vein paler or concolorous, not margined by an obviously darker shade. 9
2. Male with the anterior legs most heavily tufted; tibiae with dense long hairy and scaly vestiture capable of fan-like and brush-like expansion 3
 Male with anterior legs least modified; the tibiae not tufted..... 4
3. Male antennae lengthily ciliated; primaries creamy yellow with narrow dark streaks in the interspaces; secondaries white in both sexes*multilinea*.
4. Middle tibiae of the male heavily tufted, the outer terminal spur curved and flattened, pointed at the tip; lateral ciliations of the antennae prominent toward tip; anal tufts very large..... 5
 Middle tibiae of male tufted, but not prominently so; outer terminal spur short, straight, cylindrical; antennal ciliations not prominent and not longer toward tip; anal tufts moderate..... 6
5. Very robust, wings shorter; primaries reddish, very streaky; secondaries fuscous brown, even, leg tuftings of male discolorous*commoides*.
 Less robust, wings longer, more pointed; primaries with narrow reddish streakings over a pale luteous base; secondaries white with a smoky outer band and veins*phragmatidicola*.
6. Secondaries with veins and margins obviously smoky, the female darker than the male 7
 Secondaries white, the veins faintly or not at all marked..... 8
7. Primaries smoky gray over reddish, not obviously strigate; the white shade on the median vein obscured to near the end of cell*imperfecta*.
 Primaries red over a luteous base, the black shade beneath the median vein very prominent*calgariana*.
8. Primaries straw yellow, scarcely strigate, transverse posterior line wanting; secondaries snowy white, opaque.....*stolata*.
 Primaries reddish gray over yellowish; strigate; veins blackish lined; transverse posterior line punctiform, complete; secondaries semitransparent*oregona*.
9. Primaries reddish, so narrowly strigate as to seem almost even; secondaries white with a yellowish tinge, the veins smoky*roscola*.
 Primaries very pale luteous, strigate with darker luteous; size large; wings broad; secondaries white with the veins yellowish*farcta*.
 Primaries as before, but with the markings hardly obvious; size smaller; primaries narrower, more trigonate, more pointed at apex; secondaries white ...*palliseca*.

Having given in a general way the essential characters of the groups and of the species to be referred to them, it remains to differentiate the groups before taking up the species individually.

1. Thorax with a sharp ridge or crest behind the collar, ordinary spots present on the primaries.....Group *Unipuncta*.
- Thorax with a divided crest behind the collar or without obvious tufting of any kind..... 2

2. Ordinary spots both obvious, transverse posterior line of primaries geminate.
 Group *Pseudargyria*.
 Orbicular always absent; reniform reduced to a black or white dot or altogether wanting..... 3
3. Collar without marking of any kind.....Group *Pallens*.
 Collar white inferiorly, or at least much paler than upper half...Group *Albilinea*.
 Collar with transverse lines of different colors, culminating in a broad purplish band below a whitish tipGroup *Juncicola*.
 Collar with one, two, or three transverse dusky lines..... 4
4. Primaries narrow, elongate, apex acute, outer margin slightly excavated to vein 2, and there obtusely angulated; primaries strigate, no prominent maculation.
 Group *Extincta*.
 Primaries trigonate or obtuse, apex not acute, not subfalcate below 5
5. Median vein obscured by a dusky shade, marked by a white spot at its end.
 Group *Subpunctata*.
 Median vein white or at least concolorous, and not obscured by a dusky shade. 6
6. Rather slight, small species, vestiture with a scaly admixture; a dark shade extends through the center of the primaries from base to outer margin....Group *Ligata*.
 Robust, stout species, vestiture hair or flattened hair; no dark shade extending continuously from base to outer margin 7
7. Primaries obtuse, broader, very much rayed or streaky; median vein white, not obviously margined by a darker shade; no black discal dot; transverse posterior line always completeGroup *Insueta*.
 Primaries narrower, more trigonate, with marked apex; streaking not contrasting and tends to disappear; median vein, if white, marked by an accompanying dusky shade below it; if maculate at all, discal black dot is present; transverse posterior line rarely complete and tends to disappear altogether.
 Group *Phragmatidicola*.

LEUCANIA LUTINA, new name.

Leucania velutina SMITH, Proc. U. S. Nat. Mus., XXII, 1900, p. 480.

Ground color reddish luteous, washed with red brown, especially beyond the middle of primaries. Thorax with a narrow, sharp crest; disk carneous. Palpi reddish gray above, deep velvety brown at the sides. Abdomen washed with carmine red. Primaries with an irregular, diffuse, purplish shade along the submedian vein. Basal line vaguely indicated. Transverse anterior line narrow, single, yellowish, a little oblique outwardly to the middle, and then with a small angle a little oblique inwardly. Transverse posterior line forming an acute angle just below the costa, then evenly oblique to the hind margin; narrow, pale, margined on each side by darker red brown. Subterminal line narrow, yellowish, irregular, preceded by a few small, obscure dark spots, the terminal space a little paler than the rest of the wing. Fringes rust red. A vague dusky median shade line is marked below the cell. Orbicular moderate in size, a little irregular, annulate with yellow. Reniform of good size, oblique, oblong, sides outlined in yellow, upper and lower margins obscure. Secondaries semitransparent at base, blackish outwardly, with carmine interlined fringes and a carmine wash on the disk. Under side

of body velvety dark brown. Primaries brown with a carmine wash, with a blackish discal spot and a blackish outer line. Secondaries with a carmine powdering along costal margin, apex, and half of outer margin; with a broken, dusky outer line and a narrow discal spot.

Expanse.—1.56 inches (39 mm.).

Habitat.—Biscayne Bay, Florida (Mrs. Slosson).

The species has the wing form of *unipuncta* and its general build. The markings are all very narrow, thread-like, perfectly distinct, and yet not contrasting. In color and general appearance it is entirely unlike any of our described forms, though like some of the southern species, from which it seems to be also sufficiently distinct.

The type and only specimen is a female, lacking antennæ, but otherwise in good condition.

I find that Guenée has used the name *velutina* in this genus, and am under the necessity of making a change. I have made as small a one as possible.

LEUCANIA UNIPUNCTA Haworth.

Noctua unipuncta HAWORTH, Lep. Britt., II, 1810, p. 177.

Leucania unipuncta FLINT, in Harris Inj. Ins., 1862, p. 627, figs. 274, 275, 276.—GROTE, Proc. Ent. Soc. Phila., III, 1864, p. 540.—RILEY, 2d Rept. Ins. Mo., 1870, p. 37, figs. 11, 14–16; 3d Rept. U. S. Ent. Comm., 1883, pp. 89–156.

Leucania extranea GUENÉE, Spec. Gen., Noct., I, 1852, p. 77.—WALKER, C. B., Mus., Het., IX, 1856, p. 93.—GROTE and ROBINSON, Trans. Am. Ent. Soc., II, 1869, p. 77, pr. syn.

Ground color of head, thorax, and primaries a reddish fawn gray, varying toward gray, luteous, and clearer red brown. Palpi a little darker at sides and head often a little darker in front. Collar with a pale, surmounted by a darker transverse, line. Thorax concolorous. Primaries more or less irrorate with dark or blackish scales, which increase in number and tend to darken the outer parts of the wing. Transverse anterior line not traceable or indicated by venular points. A dark point indicates the claviform. Transverse posterior line well removed outwardly, punctiform, variably evident, sometimes scarcely traceable, sometimes geminate, never very prominent. Both ordinary spots are marked as lighter shadings, but are not outlined. Orbicular oval, decumbent. Reniform irregular, marked inferiorly by a white dot at the end of the median vein, which is dusky shaded. A blackish oblique shade line extends from the transverse posterior line on vein 5 to the outer margin at the apex. Fringes short, concolorous. Secondaries smoky brown, tending to become whitish or partly translucent toward base; veins marked and discal lunule evident in the paler examples; fringes whitish or yellowish, somewhat contrasting. Beneath whitish, powdery, primaries with disk smoky and with a smoky costal spot toward apex. Secondaries with costal and outer margins powdery, darker, and with a small black discal lunule.

Expanse.—1.40 to 1.75 inches (35 to 44 mm).

Habitat.—Canada to Florida, to Texas, to the Rocky Mountains; New Mexico; Fort Collins, Colorado; Cartwright, Manitoba.

This is the most common of the species and the most widely distributed. It extends into Mexico and South America, and in our own country is of economic importance. The larva is the Army worm, and the literature is extensive. In the third Report of the Entomological Commission, above cited, the bibliography is fully given to its date. Since then it has been written about in almost every State in which it occurs.

The structural characters of the species are elsewhere referred to, and it remains only to be said that the actual range of variation is not great—chiefly a matter of lighter or darker.

The species occurs throughout the year, but becomes most abundant in September, when it often drives off every other species from sugar.

LEUCANIA PSEUDARGYRIA Guenée.

Leucania pseudargyria GUENÉE, Spec. Gen., Noct., I, 1852, p. 74.—CAULFIELD, Can. Ent., VI, 1874, p. 132, larva.—SPEYER, Stett. Ent. Zeit., XXXVI, 1875, p. 113.—FRENCH, Can. Ent., XIII, 1881, p. 24, larva.

Mythimna pseudargyria WALKER, C. B., Mus., Het., IX, 1856, p. 77.

Leucania pseudargyria, var. *callida* GROTE, New List, 1882, p. 30, note.

Ground color grayish luteous, tending to reddish. Head sometimes rusty brown in front and occasionally the inferior half of the collar is also rusty; but usually it is concolorous. The little tuft behind the collar is sometimes rusty, but more usually concolorous. Primaries very finely speckled with smoky, blackish, or reddish. Transverse anterior line often reduced to black points on the veins or black lunules in the interspaces; when best defined the venular dots are obvious and the outcurves in the interspaces are wide. Transverse posterior line is usually a very even series of venular dots, almost rigidly parallel with the outer margin; sometimes the line is geminate and an inner line of dots parallels that already mentioned; but this inner line is rarely complete and tends to become irregular. There is a series of small terminal dots in the interspaces. The ordinary spots are both obvious, paler than the rest of the wing, not outlined. Orbicular round or nearly so, varying in size. Reniform moderate or rather small, vague kidney shaped with a small black dot at the end of the cell. The terminal area is slightly darker in most examples. Secondaries from pale smoky to black, the fringes lighter, else nearly uniform. Beneath obscure smoky, yellowish, the primaries darker on the disk, with a blackish costal spot from which a punctiform line sometimes crosses the wing. Secondaries paler, sometimes immaculate, sometimes with a discal dot, and sometimes with a series of venular dots forming an exterior line.

Expanse.—1.30 to 1.85 inches (33–46 mm.).

Habitat.—Canada, July and August; New Hampshire, July; New Jersey, April, May, June, July; New York, May to August; Cleveland, Ohio, in June; Glenwood Springs, Colorado, in April.

As a whole this common species occurs east of the Rocky Mountains and does not seem to extend into the Southern States. The sexual structures have been sufficiently noted elsewhere. The males are uniformly larger than the females and sometimes the disproportion is very striking.

Besides this variation in size there is a difference in color, the tendency being to a reddish tint. The distinctly red form Mr. Grote named *callida*, and comparing it with Guenée's *obusta* in the British Museum, I concluded that the two were identical. The species was described as from America, and Walker credits it to the United States, from Doubleday. Mr. Grote, in 1882, referred it somewhat doubtfully as a synonym of *pseudargyria*, and I saw no reason to differ with him. Now Sir George Hampson declares that Guenée's species is from Tasmania; hence should not be associated with the American form. I therefore restore Mr. Grote's term *callida* to indicate the red form of *pseudargyria*.

LEUCANIA PILIPALPIS Grote.

Heliophila pilipalpis GROTE, Proc. Bost. Soc. Nat. Hist., XVIII, 1875, p. 415.

"A male specimen having the facies and ornamentation of *pseudargyria* Guen., but without the exaggerated tufting of abdomen and tibiae. Stout, with hairy eyes and smooth front, and with a curious fan-shaped tuft of spreading hair arising from the upper surface of the second joint of the unusually prominent palpi. Head, thorax, and anterior wings concolorous, fawn gray, like pale specimens of its ally. Forewings sparsely speckled with black. Median lines fragmentary, composed of black marks; transverse anterior line outwardly oblique, subobsolete. Cell shaded with black. Orbicular spot wanting. Reniform, narrow, pale, S-shaped, intersecting inferiorly the black discal shade. Transverse posterior line formed of double dots, connected as in *pseudargyria*, but the line is more oblique and inwardly removed. Fringes pinkish, as is the internal margin, the latter showing an accumulation of the black irrorations. Hind wings whitish, with a smoky clouding outwardly above vein 2. Beneath whitish, without markings, with the fringes on fore wings pink, and the black transverse line visible on costa."

Expanse.—1.72 inches (43 mm.).

Habitat.—Appalachicola, Florida (Thaxter).

Since seeing the original type of this species I have seen only one other example of this species, a female, which, through the courtesy of Mr. Schaus, is now before me. It is in poor condition, but undoubtedly this species. Compared with the description of the male, the transverse anterior line is less obvious and the reniform is not S-shaped. Otherwise the agreement is close.

The palpi in the female are unusually long and slender for a member of this genus, are closely clothed, and without special modification.

LEUCANIA SUBPUNCTATA Harvey.

Heliophila subpunctata HARVEY, Bull. Buff. Soc. Nat. Sci., III, 1875, p. 8.

Leucania subpunctata SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 189.

Leucania complicata STRECKER, Lep. Rhop. and Het., Suppl., I, 1898, p. 9.

Color a dull, grayish red-brown over a yellowish base. Head with two darker transverse lines on front. Collar with three lighter and three smoky lines alternating. The patagiae are much powdered with blackish. Primaries with a dark smoky or blackish shade over the median vein, relieving a white dot at its end and extending beyond it nearly to the transverse posterior line. In the costal region the veins are whitish, the interspaces streaked with blackish. Along the inner margin is a paler, more yellowish area in which the streakings are lighter. The terminal area is dark, limited above by a somewhat yellowish oblique subapical shade. Transverse posterior line punctiform, complete. Secondaries white, somewhat translucent, veins and outer border smoky. Beneath, primaries smoky with a reddish tinge; a black spot on costa toward apex from which a smoky line may extend across the wing. Secondaries whitish, with the costal and outer margins more or less obviously reddish gray, powdery.

Expanse.—1.35 to 1.52 inches (34 to 38 mm.).

Habitat.—Agricultural College, Mississippi, in October; Harris County and elsewhere in Texas in March; New Mexico, near its southern border.

This seems to be locally common in Texas; but it was many years before I had an example in my collection. At present I have eleven specimens, representing both sexes, and except for size and for a little lighter or a little darker general effect there is no variation.

The structural features and other distinctive characters are elsewhere referred to.

Complicata Strecker was described from a rather small New Mexican specimen before the species had turned up in large numbers in Texas.

LEUCANIA LUTEOPALLENS, new species.

Leucania pallens SPEYER, Stett. Ent. Zeit., XXXVI, 1875, p. 112, and of American authors generally.

Ground color a creamy yellow, the primaries with the veins paler, the interspaces with somewhat more luteous streakings. Head, collar, and thorax immaculate. The median vein and its lower branches at the end of the cell tend to paler, and a slightly darker shade is usually noticeable below the median. A black discal dot at the end of the cell. Transverse posterior line reduced to two black dots. Secondaries white, the veins on disk and a small area of the disk itself tinged with blackish. Beneath yellowish white; primaries with a blackish streaking at the end of the cell and an outer dusky venular band; secondaries

with a tendency to a dotted outer line, which is rarely complete and may be entirely wanting.

Expanse.—1.20 to 1.36 inches (30 to 34 mm.).

Habitat.—Canada to Florida; Elizabeth, New Jersey, May and June; Anglesea, New Jersey, in April; Archer, Florida, in March.

Twenty or more examples are before me from almost every North and Middle Atlantic State, but only on a few are there dates of capture.

The sexual and other distinctive characters have been already pointed out, and the range of variation is not great. There is a little difference in depth of ground color, in the relative distinctness of the strigation, and in the amount of black on the disk of the secondaries; otherwise the specimens run very even.

It is probable that the species extends to the Mississippi Valley, and perhaps to the elevated plains beyond.

Type.—No. 6244, U.S.N.M.

LEUCANIA MINORATA Smith.

Leucania minorata SMITH, Trans. Am. Ent. Soc., XXI, 1894, p. 75, pl. v, fig. 11.

Ground color grayish luteous, head and collar sometimes obscurely darker, immaculate. Primaries quite obviously strigate, the veins paler, the interspaces with one or two or three decidedly darker strigae in the interspaces. There is always an obvious though not contrasting shade beneath the median vein, usually a smoky, curved shade on the inner margin near base, and quite frequently a decidedly blackish line between veins 5 and 6. A black dot at the end of the discal vein. Two black dots represent the remnants of the transverse posterior line. There is a series of minute black terminal dots, which may be obsolete. Secondaries with disk smoky, the margins whitish. Beneath, primaries with a larger or smaller part of the disk smoky, a more obviously blackish shading at the end of the cell. Sometimes with an indicated punctiform outer line. Secondaries white with a small black discal dot.

Expanse.—1.20 to 1.35 inches (30 to 34 mm.).

Habitat.—San Francisco, California; Corvallis, Oregon, May 20, June 12, August 24, September 17; Corfield and Livingston, Vancouver, throughout July to August 12; Calgary, Alberta, June 24 to July 30.

Eighteen examples are under examination. The term *minorata* is a misnomer, if this species is to be compared with *lucopallens*, but I considered it nearer to *oxygale* in the original description. As a matter of fact, it stands between *oxygale* and the European *pallens*, being really the American representative of the latter species.

The range of variation, except in size, is small. It is a matter of little more contrast on the primaries between the lighter and darker streakings; a little more or a little less blackish on the secondaries.

On the under side the range of variation is greater, no two examples being quite alike in the amount of black on primaries. In this point also the species agrees well with *pallens* rather than *luteopallens*.

LEUCANIA OXYGALE Grote.

Heliophila oxygale GROTE, Can. Ent., XIII, 1881, p. 14.

Leucania oxygale SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 185.

Ground color a very pale creamy, overlaid with gray, giving the impression of a pale luteous gray or dirty pale clay yellow. Head and thorax immaculate. Primaries with the veins paler and the usual dark strigations in the interspaces, but so little contrasting that the wings seem almost immaculate. The median vein is only a little paler and the dot at the end of the cell is very small or altogether wanting. So the transverse posterior line consists at most of two black venular points, and may be altogether wanting. Secondaries either uniformly smoky, or the margins may be paler and the veins darker; always with a large area of the disk blackish. Beneath, white, more or less black powdered or with smoky suffusion. The primaries may be blackish, except at the margins, and they may be black shaded only over the discal area at the end of the cell. Secondaries usually with only a light powdering of blackish scales, a small black discal dot, and a narrow, yellowish-tinted marginal area; rarely a large part of the discal area is blackish.

Expanse.—1.25 to 1.40 inches (31 to 35 mm.).

Habitat.—Alameda County, California, in June (Koebele); Los Angeles, California, May 15 (Smith); Palo Alto, California, April 30, Middle California (Barnes); Sierra Nevada, California (Hy. Edwards); Beulah, New Mexico, July 14, 18 (Cockerell); Salt Lake Utah (Hy. Edwards); Denver and Glenwood Springs, July 1 to 7, Colorado (Barnes).

Fourteen examples are under examination. It is the least contrasting of the species in this group, and the least variable in consequence. The black dots on the primary are never very strongly marked, but any one or all of them may be absent. Some specimens have quite a clear creamy-yellow tint, but the majority has a dirty gray addition that dulls the color.

While the range in size brings this species only a little above *minorata*, yet, as a matter of fact, most of the specimens exceed 1.30 inches and nearly or quite reach 1.35 inches, while in *minorata* the smaller number reach 1.30 inches, and very few indeed exceed it.

LEUCANIA RUBRIPALLENS, new species.

Ground color dull reddish luteous. Head and thorax immaculate. Primaries with the streakings well marked, though not much contrasting; median vein usually relieved by a darker shade beneath it. Discal black dot very small or entirely absent. The two dots indicating

the transverse posterior line are usually traceable, never prominent, and often entirely absent. Secondaries yellowish in tinge, ranging to a transparent smoky, the disk being always a little darker. Beneath much paler than above; primaries with the disk variably blackish, ranging from a little shading over the cell to nearly the entire surface. Secondaries more or less powdery along the costa, and a little on the outer margin, with a small discal dot on a majority of the specimens before me.

Expanse.—1.25 to 1.40 inches (31 to 35 mm.).

Habitat.—Sierra Nevada, California (Hy. Edwards); Salt Lake, Utah (Hy. Edwards); Utah in July (Poling); Denver, Colorado, June 10 (Osler); Glenwood Springs, Colorado, June 24, July 10, 16, and August 24 (Barnes).

Eleven examples are before me, and they vary little except in the depth of the red tinge and in the amount of black on the secondaries. On the underside there is the usual range of variation as to area covered by black shadings and powderings, but nothing else.

The average size of the specimens is 1.30 inches, three examples—females—exceeding that materially, while only two fall much below it.

Type.—No. 6246, U.S.N.M.

LEUCANIA PERTRACTA Morrison.

Heliophila pertracta MORRISON, Proc. Bost. Soc. Nat. Hist., XVIII, 1875, p. 120.
Leucania pertracta SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 186.

“Eyes hairy. Head and thorax concolorous with the anterior wings. The latter are uniform yellowish salmon color, interrupted only by the median vein, which is white, as well as its second and third branches; the apical costal branches are also whitish. Posterior wings and under surface white, immaculate.”

Expanse.—34 mm. Length of body, 16 mm.

Habitat.—Philadelphia, Pennsylvania.

I have already recorded my convictions as to this species; but give the above copy of the original description, since, after all, the insect may be American, though not, I am convinced, a native of Pennsylvania.

It is obviously a member of this group and quite out of the range of variation for *luteopallens*. The primaries are like *rubripallens*, but the white secondaries and underside bar it. If the same form does ever again turn up, there will be no difficulty in recognizing it.

LEUCANIA RUBRIPENNIS Grote and Robinson.

Leucania rubripennis GROTE and ROBINSON, Trans. Am. Ent. Soc., III, 1870, p. 179, pl. II, fig. 77.

Ground color a creamy, varying to pale lemon yellow, shaded with pinkish carmine, varying in depth. The carmine shading on primaries begins on the costal region before the middle, is very slight to apical

third, broadens there, but narrows again so as to leave the apex clear. Below the median vein, which is paler and may be white, the carmine fills half the submedian interspace to vein 2, and all the space between veins 2 and 3. Veins 3 and 4 are pale, and the space between them is usually more or less completely pale; but it may be entirely reddish. Above vein 4 a carmine shade begins at the end of the cell as a point and broadens out so as to reach the outer margin below the apex. No black points or dots on any of the specimens before me. Secondaries white, sometimes with the margins a little soiled. Beneath white, primaries with a pinkish or yellowish shade. Head with a rusty yellow shading in front and sometimes with a rusty line above the antennæ. Collar of the palest ground color inferiorly, rusty above and on the disk behind the collar. The front of the breast is also rusty or reddish.

Expanse.—1.34 to 1.50 inches (34 to 38 mm.).

Habitat.—Texas in August; Kansas City, Missouri, in August (Hall).

Six examples are under examination, and I have seen others. The species must be locally and seasonally common, for Belfrage seemed to have taken it in numbers; but since his time very few examples have found their way into collections. In 1898 Mr. F. J. Hall, by taking the species near Kansas City, Missouri, extended its known distribution materially; but I have no data as to how frequently it is captured there.

There is little observed variation, and the insect is altogether so well marked that no difficulty will be found in identifying it.

LEUCANIA ALBILINEA Hübner.

Leucania albilinea HÜBNER, Zutraege, Ex. Schmett, 1816, p. 25, No. 169, figs. 337, 338; Verzeichniss, 1816, p. 241.—GUENÉE, Spec. Gen., Noct., I, 1852, p. 89.—WALKER, C. B., Mus., Het., IX, 1856, p. 99.—RILEY, 9th Rept. Ins. Mo., 1877, p. 50, figs. 14, 15, all stages.—GROTE, Can. Ent., XII, 1880, p. 116.

Leucania harveyi GROTE, Bull. Buff. Soc. Nat. Sci., I, 1873, p. 9, pl. 1, fig. 14.—HARVEY, Bull. Buff. Soc. Nat. Sci., III, 1876, p. 8.—GROTE, Can. Ent., XII, 1880, p. 116, an sp. dist.—SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 186, pr. syn.

Ground color a dirty luteous, more or less smoky, varying in depth. The head tends to become rusty yellow in front. Collar whitish inferiorly, the paler shade crossed by a narrow brown line. A black or brown line surmounts the whitish area and shades into the ground color at tip. Patagiæ with a more or less obvious white line and the disk behind the collar a little white. Primaries with the brightest pale color extending from base through the cell to the apex. A similar, more irregular area of bright shade extends along the inner margin. Costal area from base nearly to apex gray, or brown streaked, not contrasting, but in contrast to the even lighter shade below it. Median vein white or at least pale, the light shade continued on veins 3 and 4 to the margin; not unusually the interspace between these veins is paler than the area above or below. A brown shading below

the median vein extends at least to its end and usually to the outer margin; often the vein is inferiorly edged with black. A black narrow line extends from base into the submedian interspace and forms a loop near the middle of the wing, suggesting a claviform. Above vein 4 there is a triangular dusky area which, on the outer margin, reaches almost to the apex. The terminal space may be leaden gray or concolorous, or there may be a series of black marks indicating the subterminal line. There may be a small or a large black discal dot or none at all. It may break up into two of equal or unequal size or even into three, and these indicate the reniform. Fringes usually darker, with a pale line at base. Secondaries smoky brown or blackish, even or only a little paler at the base; fringes white. Beneath, powdery gray over dirty white, the secondaries paler; the dark shading variable, forming no obvious markings.

Expanse.—1.12 to 1.32 inches (28 to 33 mm.).

Habitat.—Anglesea, New Jersey, June 10, September 3; Cleveland, Ohio, May 5, 9 (Kearfott); Glenwood Springs, Colorado, June 5 (Barnes); southern Arizona (Barnes).

The above are specific localities referring to the fourteen examples now before me. It is probable that the species occurs throughout the Eastern United States and extends into Canada. It is not impossible that the south Arizona example may represent a good species. The single specimen is only enough to create a doubt. The majority of specimens expand about 1.20 inches.

I have carefully compared Hübner's figure and have matched it perfectly in the series before me. I have little doubt that it is this species really, though the type was said to come from Buenos Ayres. Hübner's description does not help much; he says it is a *noctua genuina* and *Heliophila pallida*. To *Leucania l-album* it is rather similar, but has an entirely unique middle marking besides other variations.

On the other hand there is no doubt but that Mr. Grote intended the form here treated when he described his *harveyi*. The description fits it perfectly and fits no other.

The range of variation has been partially indicated in the description; it is not really great and yet there is enough to make quite a little difference in appearance. In the one extreme there are no black streaking and no discal dots; in the other there is black everywhere, below the cell, even in the cell; the discal spot breaks up and in every interspace along the subterminal line is a black mark or streak.

The species has a large economic bibliography which is not here referred to. The larva is known as the wheat-head army worm.

LEUCANIA OBSCURIOR, new species.

Resembles *abilinea* in general type of maculation, but is somewhat darker on the whole, with less contrast, the ornamentation much more even. The median vein is white, the shading below it does not usually

differ very greatly from that along the inner margin; but on the other hand there is a shading above the vein, continuous with the trigonate shading above vein 4. In only one example is a discal dot observable. Secondaries white at base with a smoky tinge outwardly. Beneath whitish, with a distinct yellow tinge over the costal region.

Expanse.—1.20 inches (30 mm.).

Habitat.—Cartwright, Manitoba (Heath).

Two males and two females only, all very much alike and all more or less imperfect. The material is scant to authorize a new species in this group; but the combination of dark primaries, like those in *albilinea* with pale secondaries, leads to the belief that with more material additional points of difference will be brought out. Meanwhile it is at least a well-marked local form.

Type.—No. 6246, U. S. N. M.

LEUCANIA DIFFUSA Walker.

Leucania diffusa WALKER, C. B., Mus., Het. IX, 1856, p. 94.—DRUCE, Biol. Cent. Am., Het., I, 1889, p. 262, pl. xxxvi, fig. 10.

Leucania albilinea GROTE, Ill. Essay, 1882, p. 42.—SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 186.

Leucania moderata WALKER, C. B., Mus., Het., IX, 1856, p. 114.—SMITH, Bull. 44, U. S. Nat. Mus., 1896, p. 186, pr. syn.

Ground color a very pale luteous, tending to whitish. Head with a more or less obvious rusty tinge. Pale portion of collar with a brown or blackish transverse line, the tip rusty over a black line. Patagiae with a white line on disk and on the thorax a white line behind the collar. Primaries as a whole have the region along the inner margin broadly pale; in the male the costal region is usually as light; in the female it is gray with a pinkish tinge. A loop-like claviform is more or less completely indicated in every specimen, and is attached to a narrow black basal streak. The white median vein is usually black margined beneath, and below this is a gray or brown shading. A black discal spot is present in all the specimens, and often there are two. The terminal space is usually gray or brown, and the usual triangular shading above vein 4 is well marked, though not so broad as in *albilinea*. The fringes are of the pale ground and usually have a still paler line at base. Secondaries white, becoming smoky at the outer margin, varying in this particular. Beneath white, more or less powdery; primaries with the costa broadly yellowish or creamy, the disk tending to blackish.

Expanse.—1.15 to 1.38 inches (29 to 35 mm.).

Habitat.—Nova Scotia (Walker); New Hampshire; Newton, Massachusetts; Torrington, Connecticut; Newark, May 5, August 17, and Montclair, New Jersey, August 4 (Kearfott); Anglesea, New Jersey, August 21 (J. B. S.); Iowa City, Iowa, July 29 (Wickham); Mesilla

Park, New Mexico, April 4 (Cockerell); Shovel Mountain, Texas (Barnes); City of Mexico (Druce).

Specimens from all save the first and last of the above-cited localities are at hand, with a few others that have State labels only. The range extends, therefore, from the boreal area to the Tropics, though probably not to the real tropical fauna.

In the comments on *albilinea* I referred to the fact that a large economic literature exists for that species. It is not improbable that in great part the species now under consideration is really intended, hence citations must be cautiously made. It is also highly desirable that systematic breeding be done to discover the range of variation and what, if any, differences are discoverable in the larva.

L. moderata Walker, was described from "locality unknown;" but the type in the British Museum seemed to me American and like *diffusa*; so the reference was made.

The range of variation is very like that in *albilinea*, but not so great in contrast. In every respect the insect looks and is paler. When once the attempt is made to separate out, there is no difficulty in arranging the series.

LEUCANIA LIMITATA, new species.

Very pale creamy yellow. Head a little rusty in front. Collar gray rather than white inferiorly, limited by a white, surmounted by a black line. Primaries without costal darker shading. Median vein white, margined above by a smoky brown line which beyond the cell enlarges into the usual trigonate shading. Below the median vein is a narrow yellow brown shade, the vein itself black edged near the end. A small black basal streak with a very narrow loop-like claviform. Terminal space a little darker. Secondaries white, immaculate. Beneath white or a very little yellowish, the costal region a little darker.

Expanse.—1.32 inches (33 mm.).

Habitat.—Texas, in June (Hulst coll.).

Only a single male in fair condition. It is unfortunate that no greater material of this species should be available to bring out more clearly what differences exist.

LEUCANIA TETERA, new species.

Ground color a pale creamy yellow. Head dull luteous. The white portion of collar crossed by a narrow luteous line; no defining line between the pale lower and darker upper portion. Thorax dull luteous. On the primaries the costal region becomes shaded with pink toward the apex. A small black discal dot. The usual dusky shade above vein 4, but interrupted by two white, black-edged dotlets in the interspaces, marking the subterminal line. Median vein concolorous

until near its tip, then whitish and opening into the 3-4 interspace. Below the median vein is a dusky shading, blackish at base and end of median vein, gray and reddish luteous beyond and below. The claviform barely traceable. Terminal space leaden gray except at apex. Subterminal line marked by black scales or by paler, black-margined points. A small black discal dot. Fringes white, with a yellow line at base and two narrow blackish interlines. Secondaries white, pearly, semitransparent. Beneath, primaries pale creamy, tending to pinkish along the costa; secondaries pearly white, tending to creamy along the costa.

Expanse.—1.16 to 1.28 inches (29 to 32 mm.).

Habitat.—Wilgus, Cochise County, and southern Arizona (Barnes).

Three male examples, two of them in fair condition. They are very much alike and there is no doubt as to the distinctness of the species. The genitalic differences have been already referred to, as have the superficial color characters. The anterior femur has larger tufts than usual in this group and the fore tibia is also well tufted. On the middle and hind legs the tuftings, while well developed, are not especially prominent.

Type.—No. 6247, U.S.N.M.

LEUCANIA NEPTIS, new species.

Ground color a dull, lifeless, very pale yellow; the dark shadings on the primaries are an equally lifeless yellow or smoky brown. Head tending to rusty brown. Thorax dull luteous; a white line separating the pale from the dark portion of the collar. Primaries with all save internal and median veins dusky; breaking up what in other species is the clear sweep of the paler shade to the apex. The usual trigonate shade above vein 4. The dusky shade below the median shade merges gradually into the paler ground. A small black basal dash; but in few instances can the claviform be traced. Terminal space dusky. Discal dot absent or reduced to a mere point. Fringes whitish with two dusky interlines. Secondaries white with a faint yellowish tint. Beneath very pale yellowish; primaries deeper tinted and more yellowish along the costal region.

Expanse.—1.20 to 1.40 inches (30 to 35 mm.).

Habitat.—Colorado (Neumoegen); Fort Collins, Colorado, August 13 (Kearfott).

Nine examples are before me, eight of them from badly papered specimens. One perfect example from the Neumoegen collection.

There is an undescribable lifeless shade to all these examples, giving no contrast, no defined impression—all one dull sameness.

The leg tuftings in the male are better developed than in other species of the group save *tetera*. In *neptis* the anterior leg is not materially more prominent than the others.

I have little doubt as to the specific standing of this form.

Type.—No. 6248, U.S.N.M.

LEUCANIA LIGATA Grote.

Heliophila ligata GROTE, Trans. Am. Ent. Soc., V, 1875, p. 115.

Leucania ligata STRECKER, Rept. Chief Eng., 1878-79, V, 1879, p. 1862.

This slender species has pure white secondaries and fringes in the female, while in the opposite sex these are slightly soiled. Forewings whitish ochery gray, faintly purple tinged, with the veins obsoletely white marked and accompanied by longitudinal blackish shades. Median nervure covered by a whitish streak, culminating in a white spot relieving a single inferior black dot and accompanied by a black shading which continues diffusely to external margin, and leaves a clear ochery space above it on the cell, reaching beyond the dotted transverse line. Transverse posterior line indicated by a series of black venular points. Very minute marginal black points; fringes a little paler than the wing. Thorax and head like primaries. Beneath, without discal dots or common lines; a terminal dotted line on both wings; primaries and costal region of secondaries somewhat rosy gray, else the secondaries are whitish, subpellucid. Under surface of body and legs of a slightly rosy gray. Collar faintly lined.

Expanse.—1.10 to 1.22 inches (27.5 to 30.5 mm.).

Habitat.—Texas, March to November; Florida in March; Colorado, July 31.

Twelve examples are before me, mostly from Texas; Shovel Mountain and Harris County being the only specific localities. The above is practically Mr. Grote's description, not in quotation marks, because not literally transcribed.

In general, there is a decided reddish gray tinge, a coarse black powdering, an obvious dotted transverse posterior line, and a longitudinal dark streak which extends over the white marked median vein from base, beyond it to the transverse posterior line or even the outer margin. The secondaries are rarely immaculate, but may be so in either sex; nor, on the other hand, is the smoky outer margin very extensive in any case seen by me. The species does not seem to be rare in Texas and tends to lose the reddish or purplish tinge.

LEUCANIA FLABILIS Grote.

Heliophila flabilis GROTE, Can. Ent., XIII, 1881, p. 15.

Leucania flabilis SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 189.

Very pale ochery or straw color, shaded with fuscous. The pale longitudinal shades extend along the cell over the interspaces between veins 5 and 6, nearly to the margin. A short pale shade on the interspace above and extending nearer the margin. From the base a wide

submedial shade extends outwardly to the margin. A black dot marks the reniform at median vein; an extra-mesial row of dots on the nervules, not prominent. The veins are indistinctly paler. The darkest portion of the wing is along the median vein, and a fine black streak runs along the interspace between veins 4 and 5. Hind wings whitish, vaguely soiled with fuscous exteriorly. Thorax concolorous with primaries; no lines on the collar. Beneath without marks. This species recalls in maculation *lapidaria*, but is more diffusely shaded, the spots of the outer line more numerous, the hind wings darker, the body more slender.

Expanse.—1.32 inches (33 mm.).

Habitat.—Long Island, near the seashore, in May.

The species was taken by Mr. Fred. Tepper who had a cotype, and this is the only example of *flabilis* known to me in any American collection. It is probable that the insect is very local and that may account for its absence in cabinets. I have already stated that I can see no difference between *ligata* and *flabilis* except that the latter lacks the purplish shading. But the Tepper specimen has a purplish tinge, and I have a Texas example that has as little. An expanse of 33 mm. is too great for the cotype and too great for any *ligata* known to me.

The description is essentially that originally given by Mr. Grote.

LEUCANIA RIMOSA Grote.

Heliophila rimosa GROTE, Can. Ent., XIV, 1882, p. 216.

Leucania rimosa SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 189.

Fore wings hoary gray, something like *ligata* in color; irrorate with dark speckles and with a faint warm shade, reminding one a little of *unipuncta* in these respects. Allied to *commoides*; no lines or spots visible except that there is continuous series of excessively minute subterminal dots, and the median vein is faintly marked with white and edged with black; the white color accentuated at base of third and fourth median nervules. Hind wings pale gray, whitish, veins soiled. Beneath a blackish shade marks the inception of the subterminal line on costa, and the median vein is shaded at base of nervules. Hind wings with costa darker; no lines or spots. Face and pectus a little smoky; fore tibiae pale outwardly. Thorax gray; abdomen paler.

Expanse.—1.36 inches (34 mm.).

Habitat.—Kittery Point, Maine.

No one has taken this species save Dr. Thaxter, so far as I am aware, and the original type is with him. A second specimen which he kindly sent me is smaller—only 31 mm.—and the longitudinal shading through the center of the wing is quite obvious though not conspicuous. I can not find anything to suggest *commoides*.

LEUCANIA DIA Grote.

Heliophila dia GROTE, Can. Ent., XI, 1879, p. 29; Ill. Essay, 1882, p. 56, pl. II, fig. 19.

Leucania dia SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 187.

Ground color a pale reddish gray. Head and fore breast smoky tinged. Collar with a somewhat darker line across the middle. Thorax concolorous. Primaries without strong contrasts. Veins white-marked or at least paler, the costal region gray or whitish. Interspaceal rays not prominent or contrasting. Transverse posterior line punctiform. A series of very small terminal, interspaceal dots which may be wanting. A narrow pale line at the base of the fringes. Secondaries dirty whitish, almost uniform, veins a little darker. Beneath, primaries pale reddish gray, costal region whitish to a dusky blotch about one-fourth from apex. Secondaries whitish, powdery, a little darker and more powdery over the costal area.

Expanse.—1.16 to 1.24 inches (29 to 31 mm.).

Habitat.—California; Oregon.

Three males and one female are before me. One of these agrees perfectly with Mr. Grote's description. The second is more reddish and a little larger and agrees better with the picture in the "Illustrated Essay." The others, from "Middle California," are somewhat darker and have the interspaceal streaking much better marked. The character emphasized by Mr. Grote in his description, i. e., the absence of a dusky shading along the median vein, loses force here, because, while it is by no means prominent, there is undoubtedly a smoky line on each side of the vein. The triangular dusky shading in the terminal area of the wing is also well indicated here.

The heavily clothed quadrate thorax, as against the short, obtuse wings, gives the insect a peculiarly stumpy appearance.

LEUCANIA MEGADIA, new species.

Ground color a dirty reddish gray, tending to smoky. Head varies to rusty or smoky, as does the forebreast. Collar with a blackish central line. Thorax concolorous. Primaries with veins white, interspaceal streaks obvious and tending to become black beyond the transverse posterior line. The latter is punctiform and well marked. Median vein margined by smoky shadings above and below, forming a more conspicuous white dot at its end and usually emphasized there by black scales. A distinct black or blackish basal streak in the submedian interspace. The costal region is usually paler gray. In the terminal area of the wings the dusky shadings are so disposed as to form a more or less obvious dark area over the internal angle and a trigonate shading below the apex. Secondaries smoky yellowish, nearly uniform. Beneath, primaries smoky reddish gray, disk darker

and at outer fourth a variably marked dusky costal spot; secondaries paler, the costal region black powdered.

Expanse.—1.12 to 1.36 inches (28 to 34 mm.).

Habitat.—Calgary, Alberta, June 15 to July 20; Oregon (Koebele); Pullman, Washington, May 25 (Piper); Nevada County, California (Koebele); Yellowstone Park, Wyoming, July 10; Denver, Colorado, June 30; Chiricahua Mountains, Arizona, July 4 (?).

This species has the body less robust and the wings broader than in *dia*, hence it looks decidedly larger, an appearance which was not borne out on actual measurement in all cases. The average runs only 1 or 2 millimeters larger.

Sixteen examples, varying in distinctness: the Calgary specimens are probably all from Mr. Dod, the Yellowstone example is from Dr. Barnes. One example from Calgary is almost as even in color as *dia*, but has the black basal streak obvious. This latter feature will serve to distinguish the two small species in the group without difficulty.

There is a decided tendency to a red shading and one specimen is as red as any *insueta* I have ever seen, the costa in this case being almost white. The single example from the Chiricahua Mountains is a female and in such condition that the reference is not positively made.

Type.—No. 6249, U.S.N.M.

LEUCANIA HETERODOXA Smith.

Leucania heterodoxa SMITH, Trans. Am. Ent. Soc., XXI, 1894, p. 75, pl. v, fig. 7.

Ground color a dirty luteous gray with a varying reddish tinge. The head may be either a little lighter or a little darker than the ground color. The tuftings of the front legs in the male are conspicuously darker. Collar with a dusky or black median line either relieved by paler lines above and below, or with a second, less conspicuous line just below tip. Disk of thorax and patagiæ powdery, the latter tending to a marginal line. Primaries obviously and often conspicuously streaked in the interspaces; the veins white or whitish. Median vein white, forming a white spot at its end, margined by a darker shading. The costal region is paler, sometimes a little contrasting, until just before the apex. The transverse posterior line is a series of black venular dots, evenly curved and nearly parallel with the outer margin. The dark shadings in the wing are above the anal angle and from the transverse posterior line on vein 2 or 3, obliquely to the apex. In some examples there is a costal shade before the apex and in some cases the apex is dusky. There is a series of small terminal black dots. The fringes are dusky and have a pale line at base. Secondaries smoky or fuscous, fringes paler. Beneath powdery, varying in tint. Primaries are from reddish gray to smoky and have a blackish costal spot toward apex. Secondaries are whitish, becoming more powdery and more reddish in the costal region.

Expanse.—1.28 to 1.40 inches (32 to 35 mm.).

Habitat.—Pullman, Washington, May 25, June 10 (Piper); Corvallis, Oregon, May 1 to June 6 (Cordley); Corfield, Vancouver; Nevada County, California (red number 342 Koebele); Denver, Colorado, June 30; Boulder, Colorado, August 10; St. Anthony Park, Minnesota, June 25 (Lugger); Sierra Nevada, California; Laggan, British Columbia, 5,000 feet, July 2.

A long series of examples is before me from all save the last two mentioned of the above localities. It establishes the species and illustrates its range of variation, which is narrow. There is a very slight tendency to a reddish tinge, but nothing to cause confusion with *insucta*, from which this species is also well separated by the absence of a black basal streak. In some examples the indications of such a streak may be made out by close scrutiny, but I have never found a case where there was enough to give any reason for hesitation.

Aside from this it is a mere matter of lighter or darker, or more or less contrast, and this seems to depend somewhat on the age of the specimen.

The sexual and other structural characters have been elsewhere defined.

LEUCANIA INSUETA Guenée.

Leucania insucta GUENÉE, Spec. Gen., Noct., I, 1852, p. 81.—WALKER, C. B.,

Mus., Het., IX, 1856, p. 95.—SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 188.

Leucania connooides GROTE, Can. Ent., IX, 1877, p. 28.

Heliophila adonea GROTE, Bull. Buff. Soc. Nat. Sci., II, 1874, p. 159.—SMITH,

Bull. 44, U. S. Nat. Mus., 1893, p. 188, pr. syn.

Leucania mimica STRECKER, Lep. Rhop. et. Het., Supp. II, 1899, p. 6.

Ground color a pale reddish luteous. Head a little lighter or a little darker, but always uniform. Collar with a smoky or blackish central line. Thorax more reddish gray, speckled lightly with black. Primaries streaked and shaded with brick red or even darker red brown. Costal region always paler and sometimes white. Veins white, or at least paler. Median vein white, enlarging into a little spot at its end, shaded on each side so as to darken the center of the wing. A short black basal streak in the submedian interspace. A shorter dark brown or blackish streak on the hind margin near base. Transverse posterior line black, punctiform, evenly curved. An oblique brown shade over the anal angle and a second from vein 2 at the transverse posterior line to outer margin below apex. The white veins are often a little expanded at the base of the fringes. Sometimes a series of small terminal black dots, rarely an almost continuous brown line; often neither. Secondaries whitish or yellowish at base, darkening outwardly to smoky or blackish; fringes with a yellow line at base. Beneath, primaries reddish gray, powdery, with a smoky costal dot from which starts a variably complete punctiform extra median line;

secondaries whitish, except in apical and costal region, with a more or less complete, punctiform extra median line.

Expanse.—1.24 to 1.44 inches (31 to 36 mm.).

Habitat.—Nova Scotia; Canada in July; New York, June to August; Newton, Massachusetts; Missouri; Glenwood Springs, Colorado, September 1 (Barnes).

This is a common species, hence my material is not especially good. There are twenty or more specimens, but not well distributed as to locality and few of them dated. It is probable that the species occurs throughout the Eastern United States, but may not extend far southward.

The range of variation is much like that given for *Heterodora* and is chiefly a matter of contrast. In some examples the base is quite a clear yellow and on this a deep rich red makes a striking specimen. In others everything is dull, or there is a grayish tinge. This is the only species in which an obvious outer line is usual on the under side.

Mr. Strecker's type is the usual Colorado form, in which the contrasts are not quite so great. Yet he would hardly have made the error had he not placed it at once with *commoides* as the closest ally. From that species it is, of course, easily distinguished.

LEUCANIA EXTINGTA Guenée.

Leucania extincta GUENÉE, Spec. Gen., Noct., I, 1852, p. 79.—WALKER, C. B., Mus., Het., IX, 1856, p. 94.

Leucania limita GUENÉE, Spec. Gen., Noct., I, 1852, p. 81.—WALKER, C. B., Mus., Het., IX, 1856, p. 95.—SMITH, List Lepidoptera, 1891, p. 46, pr. syn.

Leucania scirpicola GUENÉE, Spec. Gen., Noct., I, 1854, p. 84.—WALKER, C. B., Mus., Het., IX, 1856, p. 96.—SMITH, List Lepidoptera, 1891, p. 46, pr. syn.

Heliophila amygdalina HARVEY, Can. Ent., X, 1878, p. 57.—SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 187, pr. syn.

Ground color a very pale creamy yellow, primaries streaked with blackish and silver gray, tending to a faint reddish. Head with a slight admixture of brown scales in front. Collar with two dark gray transverse lines. Thorax immaculate. Primaries with all the veins narrowly white. A whitish dot marked by black scales at the end of the median. A series of black dots forming the transverse posterior line and this line is abruptly bent inward on vein 4. Secondaries white, semitransparent, with a somewhat yellowish tint. Beneath, primaries a little smoky on disk, and with a blackish costal spot; secondaries a little yellowish and powdery along the costa.

Expanse.—1.30 to 1.44 inches (33 to 36 mm.).

Habitat.—Maine; New York; Florida; Newark, New Jersey, May 12, 16, July 25 (Buchholz, Weidt); Elizabeth, August 4 (Kemp).

Five examples, all of them from Newark and Elizabeth, New Jersey, are before me. The species is not represented in any of the large collections, and yet it has a considerable range. Druce records it from

Mexico and adds *insueta* Guenée and *antica* Walker to the synonymy above given. As to the latter, he may be right; the description being of a South American species did not require me to identify it. As to *insueta* he is surely in error, for I compared the examples in the British Museum, and, in addition, the description does not fit at all. Guenée, who in all the other descriptions mentions the pointed apex of primaries and the very oblique hind angle, expressly states for *insueta* that they are less sharp than in *completa*, with which he compares it. In addition, mention is made of the black basal streak, obvious in *insueta* and absolutely wanting in *extincta*.

With a good example at hand it is simply impossible to mistake the species from its wing form and the gray strigation. But when the insect is a little rubbed, matters are not so easy. The characteristic wing form is destroyed by rubbed fringes; the gray interspacial lines are easily marred and there remains an almost characterless individual. It is in this way that M. Guenée fell in error.

Enough has been said under the group heading to place the species on structural characters.

LEUCANIA JUNCICOLA Guenée.

Leucania juncicola GUENÉE, Spec. Gen., Noct., I, 1852, p. 83.—WALKER, C. B., Mus., Het., IX, 1856, p. 96.

Heliophila adjuncta GROTE, Bull. Buff. Soc. Nat. Sci., II, 1874, p. 158; Bull. Buff. Soc. Nat. Sci., III, 1875, p. 8.—SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 188, pr. syn.

Ground color a rather bright creamy yellow, strigation of the primaries luteous. Head with a frontal and interantennal purplish line. Collar crossed by two dusky lines near the middle, and at the tip a series of four contiguous lines of different colors gives the impression of a reddish or purplish band. The little anterior crest has the same purplish markings. Primaries with the veins whitish; the interspaces with at least two narrow, luteous lines. Median vein a little more broadly pale, inclosing a small black dot at its tip. The transverse posterior line is usually indicated by two venular dots only, but may be complete. A black dot is in the submedian interspace about one-third from base. There are no strongly marked shadings, but it is readily seen that a somewhat darker shade extends below the median to its end, broadens out a little and continues to the outer margin, extending from vein 4 and to the apex. Another shading extends over the subcostal and, broadening out somewhat, reaches the costa before the apex. A series of very small, black terminal dots. Fringes concolorous. Secondaries somewhat pearly white at base, semitransparent, with a smoky outer border and yellowish fringes. Beneath, primaries with an obvious pinkish tinge, the disk tending to blackish. Secondaries with the costa yellowish, powdery, and a series of black terminal spots in the interspaces.

Expanse.—1.30 to 1.45 inches (32 to 36 mm.).

Habitat.—Texas in March; Florida; Alabama.

Eight examples are at hand just now, all very much alike. Except for two examples from San Antonio, they have State labels only, and not one has a date of capture. One female has a marked reddish tinge in the ground and the secondaries are almost uniformly smoky. The Florida example is more obviously streaked than the others, but differs in no further point.

The ornamentation of the collar is the most characteristic feature of the species, and this tends to getting in red or scarlet in addition to or place of the black.

LEUCANIA MULTILINEA Walker.

Leucania multilinea WALKER, C. B., Mus., Het., IX, 1856, p. 97.

Leucania commoides GROTE, Proc. Ac. Nat. Sci. Phila., 1875, p. 419.

Heliophila lupidaria GROTE, Proc. Ac. Nat. Sci. Phila., 1875, p. 419.—SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 187, pr. syn.

Ground color creamy yellow. Head immaculate. Thorax with three gray or blackish transverse lines, the upper one broadest. Disk of thorax and patagiae a little black speckled. Primaries with veins white or whitish, the strigations in the interspaces dark and well marked. Median vein white, inferiorly margined by black or brown to the end. A black dot in the white area at end of vein. A smoky shade bases on vein 4 and broadens toward the apex, which it reaches on outer margin. A dusky shading over the subcostal region and another parallel with and close to inner margin. Transverse posterior line reduced to two dots. A series of small black terminal dots. Secondaries white, with small black terminal dots. Beneath, primaries faintly yellowish, the disk more or less blackish, veins more or less black marked; secondaries somewhat yellowish and powdery along the costa.

Expanse.—1.30 to 1.40 inches (32 to 35 mm.).

Habitat.—Miami, Palm Beach, Florida (Dyar); Harris County, Texas, August 10 (Barnes); Kansas (Snow); Albany, New York, June and July; Winnipeg, Manitoba (Hanham).

A series of thirteen examples shows little variation, and among the strigate rather obtuse winged forms the pure white secondaries of both sexes make this easily separable. The only species with which it is likely to be confounded is *juncicola*, and that can be very easily determined if the material is at all good.

LEUCANIA COMMOIDES Guenée.

Leucania commoides GUENÉE, Spec. Gen., Noct., I, 1852, p. 86.—WALKER, C. B., Mus., Het., IX, 1856, p. 96.—SPEYER, Stett. Ent. Zeit., XXXVI, 1875, p. 113.

Ground color dull grayish luteous, more or less brightened by red or brown. Head tends to rusty brown. Collar with three leaden

gray transverse lines. Thorax a little black powdered. Primaries more or less shaded with red brown and streaked with black. A prominent black streak below the broadly white median vein. A black dot at the branching of the median vein. Veins narrowly white, and hence the costal region is a little paler. A black mark is on the inner margin near the base; another is in the submedian interspace toward the anal angle. Other black streaks are in the interspaces above vein 3, forming the base of a triangular dusky shade. Transverse posterior line punctiform, not well marked. A series of black terminal dots. Secondaries dirty fuscous, with pale yellowish fringes. Beneath, the sexual tuftings are discolored, brown. Primaries reddish gray, powdery, a little darker on the disk. Secondaries whitish, with the costal area powdery, yellowish.

Expanse.—1.40 to 1.50 inches (35 to 37.5 mm).

Habitat.—Nova Scotia; Canada; Winnipeg, Manitoba, July 2 (Hanhani); Maine (Fernald); Massachusetts; Albany, New York, June 22 (Bailey); New York, June to August; Wisconsin; Minnesota; Illinois; New Mexico (Snow); Colorado; Florida in March.

The species has a wide distribution, is not at all rare, and is easily recognized. The prominent black streak beneath the white median vein and the dark red color are distinctive characteristics. Add to this the prominent abdominal and leg tuftings of the male and the species becomes unmistakable.

The leg tuftings are as follows: Anterior femora with a continuous fringing of hairy scales beneath, making a thick mass, but no tuft. Tibia with a thick outward scaling, but no tuftings or longer hair. Middle leg somewhat shortened, tibial spurs long, the inner curved and somewhat flattened. Femora with continuous dense fringing of long hair and scales, longer at base. Tibia with long hair tufts in front and at sides, capable of brush-like expansion; one at the side may be also capable of fan-like expansion. Posterior femora with long hair fringe basally. Tibia with longer hair outwardly toward base, but no brush.

The harpes of the genitalia are densely clothed outwardly with long yellow hair, intermixed with broadly flattened scales, forming a mass that can be fluffily expanded, making neither a definite brush nor fan-like expansion.

LEUCANIA PHRAGMATIDICOLA Guenée.

Leucania phragmatidicola GUENÉE, Spec. Gen., Noct., I, 1852, p. 89.—WALKER, C. B., Mus., Het., IX, 1856, p. 97.

Heliophila phragmatidicola var. *texana* MORRISON, Proc. Bost. Soc. N. H., XVII, 1874, p. 211.

Ground color a very pale luteous, varying to grayish or reddish, sometimes reaching a decided warm fawn brown. Head and thorax concolorous. Collar with three darker transverse lines, which tend

to obsolescence, that just below the tip being broadest. Anterior crest and patagiae sometimes a little speckled with blackish scales. Primaries more or less obviously strigate, the veins white or whitish, interspatial narrow lines ranging from dull luteous to smoky or even blackish. Median vein obviously white, bordered on each side by a smoky or blackish shading, that beneath being the more prominent. At the end of the vein the white enlarges as it includes the base of the branches and here a black dot precedes and a blackish or smoky shade follows the branching, thus extending for a little distance the dark shading below the median vein. A vague triangular cloud is on the outer margin above vein 4, extending to the apex, and a somewhat lighter shading extends from base through the cell, obliquely to the apex itself. A series of small black terminal dots is obvious in most specimens. Secondaries white or whitish, sometimes with a yellowish tinge, with a narrow smoky outer border and a series of terminal black dots, which, as a rule, are best marked where the smoky shading is best. Beneath, primaries creamy or reddish, powdery, tending to smoky on the disk; secondaries white except over the costal region, where it is creamy and somewhat powdery.

Expanse.—1.28 to 1.52 inches (32 to 37 mm.).

Habitat.—Canada to Florida, to Texas, to California; Iowa; Minnesota; Illinois. The dates cover every month from March to October, inclusive.

This is one of the most widely distributed, and, in a certain way, the most variable of the species. There are, obviously, two broods in the Middle Atlantic States, adults appearing in May and June and again in August and September. New Jersey specimens are before me for every month from May to October. In Florida and Texas the early dates are in March. Los Angeles, California, specimens are dated April.

Nearly forty examples are under inspection and in such variety that it would seem certain that they could be arranged in series of distinct forms, but I have failed on all bases tried.

Some specimens are almost creamy yellow, without contrasts, the median vein hardly white, its blackish border hardly traceable. The primaries seem broader, the margins subparallel. Another series is obviously gray, with or without a reddish shade, the strigation obvious, the markings over the median vein conspicuous. Here the wings seem more trigonate and the apices more pointed. Then comes a series in which the primaries seem longer and narrower, the body slighter, color decidedly reddish fawn, the median dusky streak unusually prominent, and extending almost to the transverse posterior line; but when these extremes are carefully separated out, the remaining forms block out every gap and leave us with one series only. The differential points have been elsewhere brought out.

I can not place the variety *terana* Morrison. I have nothing so small as 29 mm. in expanse, and nothing in which the lines on the collar are not at least traceable. The essential differences as pointed out by Mr. Morrison are: "They expand only 29 mm.; the collar lacks the black transverse line of the typical form; the ground color is clear and whitish, not becoming suffused with reddish or dark ochreous before the terminal space."

Mr. Grote in describing *ligata* refers to this variety as if he thought Mr. Morrison might have had such a form as his new species before him, but this seems hardly credible.

LEUCANIA IMPERFECTA Smith.

Leucania imperfecta SMITH, Trans. Am. Ent. Soc., XXI, 1894, p. 76.

Ground color a dull luteous, shaded with smoky or blackish. The head may be of the pale ground or of the smoky tint. Collar with three purplish black transverse lines; patagiæ blackish at base of primaries, tending to the pale ground on the disk. Primaries darker over the costa, through the middle of the wing, along the inner margin, and in the terminal space before the apex. This leaves the pale ground as a long shade through the cell from base to apex and through the submedian interspace from base to the transverse posterior line. The shadings are all quite even and not obviously strigate. Median vein accompanied by a blackish streak which may or may not darken it to the end. At the branching there is always the angular white spot, emphasized by a preceding black dot. In one specimen the vein is narrowly white throughout. The other veins may or may not be partly white marked. There may be a series of small black terminal dots and a yellowish line at the base of the fringes.

Secondaries, transparent, somewhat pearly white at base, the veins smoky or blackish; a somewhat diffuse, smoky margin, variable in width. Fringes with a yellowish line at base. Beneath, primaries gray, powdery, the disk tending to and sometimes all blackish. Secondaries white, powdery over the costal and apical area.

Expanse.—1.28 to 1.52 inches (32 to 38 mm.).

Habitat.—Santa Rita Mountains, Arizona, June 19 (Schwarz); Chiricahua Mountains, Arizona, June 26 (Hubbard); Wilgus, Cochise County, Huachuca Mountains, and southern Arizona (Burnes).

Seven examples from so many localities in Arizona indicate that it is not really a rare species. There seems to be little variation except in size, and that is not sexual, since the largest and smallest examples are both males.

In the male the sexual tuftings are not very prominent. On the anterior legs the femora have a moderate scale fringing at base, becoming shorter toward tip; the tibia is a little scale thickened outwardly. On the middle leg the femoral fringe is a little longer, the tibia is

decidedly thickened with long hair outwardly, not forming obvious tufts. On the posterior legs the femoral fringe is much longer and reaches almost to base; the tibiæ have long thin hair which does not form tufts. The anal tuftings are not very dense exteriorly, but there are two pencils of yellow hair within the genital cavity.

LEUCANIA ANTEROCLARA, new species.

Ground color a very pale luteous, almost whitish or creamy. Collar paler with three more or less obvious transverse bands which tend to and sometimes are purplish. Primaries obviously streaky but varying in the amount of contrast. Veins paler, the median whitish, as a rule, and 3 and 4 may be whitish for a part or all their course. A smoky or olivaceous luteous shading below the median vein. Discal dot a mere point which may be altogether absent. Transverse posterior line usually reduced to two black points, never complete. There is a very well-marked tendency to darker streaks above vein 4, emphasizing the triangular dusky subapical shade. In some specimens a series of small black terminal dots is obvious. Secondaries white, with a pearly luster or yellowish tinge in the male, with a vague dusky outer shading, the veins dusky; in the female with a broader, smoky border and the entire wings tending to dusky. Beneath, primaries creamy to reddish, more or less powdery, the disk more or less blackish. Secondaries white, the costal margin creamy, powdery.

Expanse.—1.40 to 1.56 inches (35 to 39 mm.).

Habitat.—Calgary, Alberta, June 25, July 10, August 13 (Dod); Yellowstone Park, Wyoming, August, (Barnes); Corvallis, Oregon, July 6 (Cordley); Glenwood Springs, Colorado, June 10 (Barnes).

Twenty-one specimens are under examination; all the females a little darker and more streaky than the males.

The differences between this species and *phragmatidicola* have been already discussed. Comparing two series their distinctness is obvious; comparing selected individuals of each series the sexual characters might have to be resorted to. It is suggestive of a local form that I have no *phragmatidicola* from the range given for this species, nor any example of this species within the range given for *phragmatidicola*.

In the male the anterior femora have long, scaly fringes more than half the distance from base; the tibiæ are thickened with scaly vestiture outwardly. Middle legs with equal femoral fringes for their entire length. Tibiæ with long hair, capable of partly fan-like expansion in front and at the sides; the outer spurs short and cylindrical. Posterior femora fringed their full length, the fringe longer at base; tibiæ with somewhat longer thin hair outwardly. The harpes are clothed outwardly with dense hair and scales but these do not form prominent tuftings. Altogether the characters, while of the same type as in *phragmatidicola*, are very much reduced.

Type.—No. 6250, U.S.N.M.

LEUCANIA CALGARIANA, new species.

Ground color a pale luteous, overlaid, streaked or washed with red. Collar almost whitish, quite contrasting, crossed by three dark gray transverse lines. Primaries obviously strigate. Median vein conspicuously white; its branches (three and four) also white as a rule and, in addition, most of the other veins are more or less whitish. A blackish or at least darker shade below the median vein and extending vaguely beyond it to form the usual trigonate subapical cloud. Discal black dot small or wanting. Transverse posterior line reduced to two dotlets or altogether wanting. Secondaries white or slightly yellowish, with a more or less obvious smoky margin. Beneath, primaries reddish gray, powdery, tending to a blackish disk. Secondaries white, costal region reddish, powdery.

Expanse.—1.48 to 1.56 inches (37 to 39 mm.).

Habitat.—Calgary, Alberta, June 20 to July 28 (F. H. Wolley Dod).

Ten examples, all from Mr. Dod and all in good condition.

This species is conspicuously different in color from the others of this series and is also the largest in average expanse. It is most nearly allied to *auteroclara* and is that species suffused with red. Whether it is merely a color variety or not I can not now say. Nothing like it has come from other localities. Mr. Dod has sent me about twenty examples of both forms and there is no difficulty whatever in separating the two. I prefer, under the circumstances, to risk the specific name until a careful study of the early stages determines the status of forms.

Type.—No. 6243, U.S.N.M.

LEUCANIA STOLATA Smith.

Leucania stolata SMITH, Trans. Am. Ent. Soc., XXI, 1894, p. 76, pl. v, fig. 8.

Ground color a pale straw yellow. Collar with two transverse dark lines. Patagiae with a dusky powdering near the margin. Primaries with the median vein white, a short spur marking the inception of vein 2, while veins 3 and 4 are white a little distance from their point of inception. A smoky brown shade accompanies this line inferiorly, and extends beyond the cell as an elongate dusky triangle between veins 4 and 6, fading out before the margin is reached. A less distinct brownish shade extends along the inner margin, and a vague smoky tinge is apparent over the costal and apical region. Between the veins, beyond the cell, are faint darker longitudinal brown lines, giving the wing there a feebly strigate appearance. A series of small black terminal dots and a small dot at the end of the median vein. Secondaries white. Beneath white, feebly irrorate, primaries with a somewhat yellowish tinge.

Expanse.—1.28 inches (32 mm.).

Habitat. Arizona.

I have seen nothing like this since the original description was published; hence the type is yet unique.

LEUCANIA OREGONA, new species.

Ground color pale fawn or reddish gray. Collar with two darker transverse lines. Disk of thorax a little powdery. Primaries obviously strigate. Veins white or nearly so, the end of the median forming an obvious white mark emphasized by a preceding black dot. A smoky line below the median vein, extending beyond it above vein 4 to form the usual subapical dusky cloud. Transverse posterior line punctiform, complete. Terminal space and fringes smoky. Secondaries white, with a series of black terminal marks. Beneath reddish gray, powdery; secondaries white, costal region powdery reddish gray.

Expanse.—1.20 inches (30 mm.).

Habitat.—Corvallis, Oregon, at light, April 11 (Cordley).

One male in very fair condition. The species resembles a pale, much reduced *subpunctata*, and is altogether different from anything else in this group.

The femoral fringes are present in a reduced form in this species, and all the tibiae have long, thin, hairy clothing, but not any of them have it to form tufts of any kind.

LEUCANIA ROSEOLA Smith.

Leucania roseola SMITH, Trans. Am. Ent. Soc., XXI, 1894, p. 75, pl. v, fig. 9.

Ground color very pale yellow, suffused with red of varying shade, tending to light brick red. Collar with three somewhat darker transverse lines. Primaries with veins paler, the intervals so closely strigate that the impression is given of an almost even color. Median vein not contrasting, only a little paler at tips. No obvious discal dot, but a slightly dusky shading beyond the forking. Transverse posterior line a complete series of smoky dots or absent altogether, with all the intermediate forms and everything in favor of the obsolescence of the dots. Secondaries white. Beneath reddish gray, the primaries with an irregular outer venular band. Secondaries white, except on the costal area.

Expanse.—1.46 to 1.56 inches (36 to 39 mm.).

Habitat.—Pullman, Washington, June 12 (Piper); Corvallis, Oregon, June 20 (Cordley); British Columbia in July; Livingston, Vancouver, July 11

Eight examples are at hand just now and I have seen others. The almost uniform red color of the wing without any contrasts identifies this form as compared with *farcta*.

LEUCANIA FARCTA, Grote.

Heliophila farcta GROTE, Can. Ent., XIII, 1881, p. 15.

Leucania farcta SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 188.

Ground color a pale creamy yellow. Collar with three somewhat purplish transverse lines. Primaries strigate, but without contrasts. The median vein is white or whitish, without contrast or obvious margins. A black dot at the end of the cell. Transverse posterior line reduced to two black points. A faint triangular cloud below apex. A series of black terminal dots. Secondaries white. Beneath, primaries yellowish, only a little powdered on the disk; secondaries with powdery costa and some black dots on the outer margin.

Expanse.—1.46 to 1.56 inches (36.5 to 39 mm.).

Habitat.—Los Angeles, California, April 16 (Howard); Los Angeles County, in April (Koebele); Fresno, California (Schwarz); Sierra Nevada (Henry Edwards).

Five examples are under examination; all very much alike. The species is an easily recognizable one with its very pale colors and simple, obscure maculation.

LEUCANIA PALLISECA, new species.

Ground color a very pale whitish yellow. Collar with three dusky transverse bands. Primaries feebly and not contrastingly strigate, all ordinary markings reduced to the vanishing point. Median vein scarcely defined in any way. Discal dot minute or wanting. Transverse posterior line consists of very small black dots and is never complete; sometimes wanting. A series of minute terminal dots. Secondaries pure white, immaculate. Beneath, white; primaries with a creamy tint and a little tendency to darken on the disk; secondaries a little powdery over the costal region.

Expanse.—1.25 to 1.45 inches (31 to 36 mm.).

Habitat.—Los Angeles County, California, in July (U.S.N.M.); Fresno, California (Schwarz); Denver, Colorado, May and October.

Seven examples are at hand and are about as nearly immaculate as a species in this series can well be. Oddly enough, all the specimens are females, and I was at first inclined to consider them female *farcta*; but I have that sex fully agreeing with the male, and therefore prefer to consider this a good species.

Type.—No. 6251, U.S.N.M.

NELEUCANIA, new genus.

Eyes hairy, without bristly lashes, round, convex, not prominent. Head as a whole moderate in size, retracted rather than prominent, but not strongly defined either way, vestiture loose, fine hair, giving a smooth woolly appearance. Palpi moderate or rather short, oblique,

reaching to and sometimes exceeding middle of front, rather slender, the terminal joint proportionately rather long, oblique or even drooping, vestiture loose. Antennae in the male feebly ciliated. Thorax moderately developed, with loose, long, thin vestiture forming no tufts and leaving collar and patagiae undefined. Abdomen reaching to or exceeding the hind angle of secondaries, more often longer and somewhat disproportionately slight. Legs unarmed except for the usual tibial spurs, in the male with more or less well-marked sexual tuftings, which are most obvious on the middle tibiae. Primaries rather narrow, elongate, the costa a little depressed, apices a little pointed, outer margin a little arcuate or entirely rigid, oblique.

The male genitalia are of the same type in all, and very much alike; there is a pair of oblong harpes, rounded at the tip, broadly or narrowly as the case may be, not modified or spined in any way, and on each a single curved corneous clasper, varying somewhat in the species.

The genus differs from *Leucania* chiefly in the narrow subequal primaries, having the costa depressed, the outer margin rather rigidly cut off, and in the long abdomen. The loose, hairy vestiture, forming no tufts and leaving the thoracic parts undefined, adds to the distinctive appearance.

As a whole the species resemble each other closely. The primaries range from pale creamy yellow to reddish, the costal edge white in the species known to me, median vein usually white and usually a dusky longitudinal shade through the middle.

Niveicosta is the best marked and a little the more robust of the species, the body parts being stouter in proportion than in any of the others. The primaries are reddish luteous, the costa narrowly yet distinctly white. The median vein is also white, though not prominently so, and it is usually accompanied by a well-marked dusky shading which may reach very close to the outer margin. The transverse posterior line is punctiform and completely traceable in all the specimens. The secondaries are slightly smoky, with a faint reddish or yellowish tinge. The male has a fringing of thin hair on the under side of the anterior and posterior femora, and on the middle femur there is an expansile tuft of hair at the base. The anterior and posterior tibiae are hairy, but not really tufted; the middle tibia has a dense brush or tuft of hair extending all the way down the outer side, and this is capable of fan-like expansion. All the specimens are from Colorado.

Bicolorata has the primaries a very pale yellow and the secondaries reddish. In some specimens the wings are practically immaculate, and of this form was the type of the species. In most good examples, however, the white costa and median vein are obvious, and in one specimen the punctiform transverse posterior line is almost complete. The body is smaller and the abdomen in both sexes is much longer than in the preceding species.

The sexual tuftings are as in the preceding species, but all very much exaggerated. The middle tibia is somewhat abbreviated and the tuftings when expanded form an almost complete circle. The posterior femur and tibia have each a tuft at base, in the former extending beyond, in the latter to the middle of the respective parts.

This species seems to have a wider distribution, extending from Colorado into Arizona and New Mexico.

Citronella is decidedly smaller than the preceding two species. The primaries are pale luteous, with a vague smoky tinge, and the secondaries are decidedly smoky in both sexes. The primaries have the costal edge white, and in all of them the smoky shade along the median vein and extending nearly to the outer margin is well marked; but the white along the median vein itself may be entirely wanting. The transverse posterior line is punctiform, complete, and well marked in all the specimens. The sexual characters are in essentials like those of *bicolorata*, but not nearly so prominent. All the examples are from Colorado.

The three species above defined are closely allied, but, I think, really distinct. With a good series, such as I have had under examination, the differences become clear, and with any good specimens under examination there should be no difficulty in placing even single examples.

Patricia is entirely different. The primaries are very pale creamy yellow or almost white, with an obvious smoky or blackish streak through the middle from base to the outer margin. The secondaries are smoky white, and as a whole the species looks white. It is about the size of *citronella*, but looks smaller and really is slighter. The sexual tuftings in the male are so reduced as to be scarcely noticeable except on close inspection. The species occurs in Colorado and New Mexico.

Prægracilis belongs here without much doubt. Mr. Grote says that it is a very slight species, yellow white and absolutely immaculate. I have not seen it. The type is from Idaho.

In tabular form the species known to me may be arranged as follows:

Primaries reddish luteous, with a punctiform transverse posterior line; secondaries whitish or smoky	<i>niveicosta</i> .
Primaries light yellow, immaculate; secondaries reddish.....	<i>bicolorata</i> .
Primaries light yellow, with a punctiform transverse posterior line; secondaries white or smoky, size smaller	<i>citronella</i> .
Primaries pale creamy, with a central smoky stripe; secondaries smoky white, size small	<i>patricia</i> .
Primaries yellow white, absolutely immaculate; very slight	<i>prægracilis</i> .

NELEUCANIA NIVEICOSTA, new species.

Ground color reddish luteous, verging to brick red. Head and collar darker, more red-brown. Thoracic disc of the ground color.

Primaries without contrasts of any kind. Costa narrowly but distinctly white. Median vein white, not broadly or prominently so, in some cases with a short white extension on the branches. There is a vague darkening through the middle of the wing, but not a real shade. Transverse posterior line indicated by a more or less complete series of venular black dots. It is not complete in any example before me; but in no case is there any doubt of its presence in great part. A series of minute black terminal dots. Secondaries whitish to smoky, even. Beneath white, ranging from almost immaculate to densely powdered. Primaries tending to a pinkish suffusion and sometimes to a black disk.

Expanse.—1.10 to 1.25 inches (27.5 to 31 mm.).

Habitat.—Glenwood Springs, Colorado, June, July, August, and September.

Five examples, all from Dr. William Barnes, and all save one in good condition. There is very little variation, and except in the somewhat lighter or deeper tint of the primaries and a little difference in the number of spots composing the transverse posterior line the specimens are the same.

Type.—No. 6252, U.S.N.M.

NELEUCANIA BICOLORATA Grote.

Heliophila bicolorata GROTE, Papilio, I, 1881, p. 154.

Leucania bicolorata SMITH, Bull. 45, U. S. Nat. Mus., 1893, p. 185.

“Male, eyes hairy; thorax untufted; tibiae unarmed. Fore wings and thorax light straw color, immaculate, concolorous. Hind wings and abdomen pale reddish. Beneath the wings are shaded with reddish, like secondaries above. There are no markings whatever.”

Expanse.—1.12 to 1.25 inches (28 to 31 mm.).

Habitat.—Colorado (Bruce); Glenwood Spring, Colorado, August 25 (Barnes); Merino Valley, New Mexico, June 26 (Wheeler Exp.); Chiricahua Mountains, Arizona, June 26 (Hubbard); Tucson, Arizona.

Six specimens are at hand, all agreeing in a general way with the above description, which is copied from Mr. Grote's original characterization. In most of them, however, the costa and median vein are obviously whitish, and in three specimens a few minute black dots indicate the transverse posterior line.

NELEUCANIA CITRONELLA, new species.

Ground color a dirty pale lemon yellow with a smoky tinge. Head and collar darker, more decidedly smoky. Primaries with the costa narrowly white, the median vein at least partly white marked. Transverse posterior line punctiform, complete in the specimens before me. A black dot on internal vein indicates the location of the transverse anterior line. A series of small black terminal dots. The

secondaries range from dirty white to smoky. Beneath, ranging from almost immaculate whitish to dirty fuscous or yellowish; sometimes with only the disk of primaries blackish.

Expanse.—1.08 to 1.15 inches (27 to 29 mm.).

Habitat.—Denver, Colorado, July 15 (Bruce, Oslar); Glenwood Springs, Colorado, July 16–August 16.

Six examples all very much alike above and no two alike beneath. There is more difference in the color of the secondaries than in the primaries, and on the whole not enough anywhere to cause doubt.

Type.—No. 6253, U.S.N.M.

NELEUCANIA PATRICIA Grote.

Heliophila patricia GROTE, Bull. Bkln. Ent. Soc., III, 1880, p. 46.

Leucania patricia SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 186.

“Fore wings yellowish buff. A silvery-white stripe on the median vein, extending on vein 4. Above this a dusky stripe, from the base outwardly to near the margin. Veins and costal edge whitish. Thorax buff. Hind wings white. Beneath whitish.”

Expanse.—1.05 to 1.12 inches (26 to 28 mm.).

Habitat.—Colorado (Bruce); Las Vegas, New Mexico; Hot Springs, New Mexico, 7,000 feet (Hulst).

Only three examples are before me at present; but I have seen others and noted no essential differences. The species is so unlike any other as to be recognizable at a glance.

NELEUCANIA PRÆGRACILIS Grote.

Heliophila prægracilis GROTE, Bull. Geol. Surv., III, 1877, p. 119.

Leucania prægracilis SMITH, Bull. 44, U. S. Nat. Mus., 1893, p. 185.

“The most slender species of the genus. Eyes hairy. Smaller and slighter than *pallens*. Yellow white, not buff as in *pallens*, absolutely immaculate. Head and thorax more yellowish. Length of primary 12 mil. One specimen, Idaho, July 6. This species seems slighter than *Senta defecta* Grt.”

The above is Mr. Grote's description, and I can add nothing to it from personal knowledge. Colorado and New Mexico are cited as additional localities in my catalogue, but I can not now remember on what authority.

Of the species catalogued by me in 1893 and not elsewhere referred to in this paper, *Leucania rufostriga* is a *Caradrina* and probably the species described by me as *C. punctivena*. Dr. Packard's type is in the Museum of Comparative Zoology at Cambridge, and Mr. Henshaw very kindly compared with it a Labrador example which Dr. Dyar suggested might have been intended. The suggestion proved accurate and I believe that the differences between this example and the British-American specimens are not sufficient to hold my species.

Leucania obriosa Guenée is a Tasmanian form, Sir George F. Hampson declares, and I am quite ready to believe him. I doubted the "Am. Sept." habitat when I saw the insect in 1892.

Leucania obusta Guenée is also said to be Tasmanian; but this subject is elsewhere referred to.

Of all the species described from our fauna there is one only that I have not seen.

LIST OF THE SPECIES.

Leucania Ochs.

lutina Smith.
velutina Smith.
 unipuncta Harvey.
extranea Guenée.
 pseudargyria Guenée.
 var. *callida* Grote.
 pilipalpis Grote.
 subpunctata Harvey.
complicata Strecker.
 luteopallens Smith.
pallens Auct. Amer.
 minorata Smith.
 oxygale Grote.
 rubripallens Smith.
 pertracta Morrison.
 rubripennis Grote and Robinson.
 albilinea Hübner.
henrici Grote.
 obscurior Smith.
 diffusa Walker.
moderata Walker.
 limitata Smith.
 tetera Smith.
 neptis Smith.
 ligata Grote.
 flabilis Grote.
 rimosa Grote.
 dia Grote.
 megadia Smith.

Leucania Ochs—Continued.

heterodoxa Smith.
 insueta Guenée.
adonea Grote.
minica Strecker.
 extincta Guenée.
linita Guenée.
scirpicola Guenée.
amygdalina Harvey.
 juncicola Guenée.
uljata Grote.
 multilinea Walker.
lapidaria Grote.
 communoides Guenée.
 phragmatidicola Guenée.
 var. *texana* Morrison.
 imperfecta Smith.
 anteroclara Smith.
 calgariana Smith.
 stolata Smith.
 oregona Smith.
 roseola Smith.
 farsa Grote.
 palliseca Smith.
 Neleucania Smith.
 niveicosta Smith.
 bicolorata Grote.
 citronella Smith.
 patricia Grote.
 pregracilis Grote.

EXPLANATION OF PLATES.

PLATE V.

1. Harpe and clasper of male *Leucania unipuncta*.
3. Harpe and clasper of male *Leucania subpunctata*.
4. Harpe and clasper of male *Leucania luteopallens*.
 The structures in *Leucania oxygale* and *Leucania rubripallens* are practically identical.
5. Harpe and clasper of male *Leucania minorata*.
6. Harpe and clasper of male *Leucania pallens* (European).
7. Harpe and clasper of male *Leucania rubripennis*.
8. Harpe and clasper of male *Leucania albilinea*.
 The characters of *Leucania obscurior* are practically identical.
9. Harpe and clasper of male *Leucania diffusa*.

10. Harpe and clasper of male *Leucania limitata*.

11. Harpe and clasper of male *Leucania tetera*.

12. Harpe and clasper of male *Leucania neptis*.

13. Harpe and clasper of male *Leucania ligata*.

The characters of *Leucania flabilis* and *Leucania rimosa* are identical.

14. Harpe and clasper of male *Leucania dia*.

15. Harpe and clasper of male *Leucania megalia*.

16. Harpe and clasper of male *Leucania heterodoxa*.

17. Harpe and clasper of male *Leucania insueta*.

18. Harpe and clasper of male *Leucania estincta*.

PLATE VI.

2. Harpe and clasper of male *Leucania pseudargyria*.

19. Harpe and clasper of male *Leucania juncicola*.

20. Harpe and clasper of male *Leucania multilinea*.

21. Harpe and clasper of male *Leucania commoides*.

22. Harpe and clasper of male *Leucania phragmatidicola*.

The characters of *Leucania antroclara* are practically like this.

23. Harpe and clasper of male *Leucania calgariana*.

24. Harpe and clasper of male *Leucania oregona*.

The characters of *Leucania imperfecta* are practically the same.

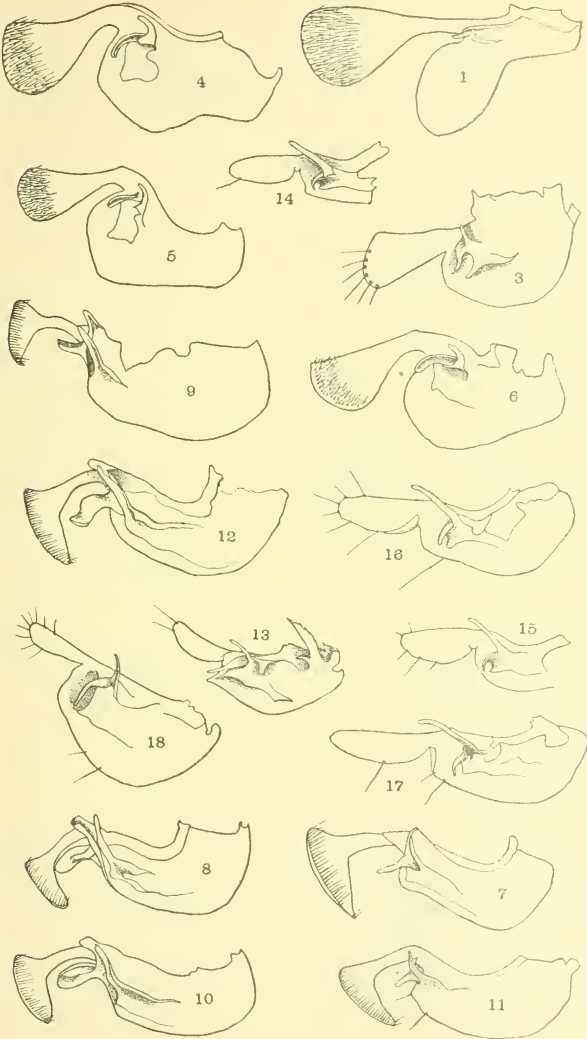
25. Harpe and clasper of male *Leucania roscola*.

26. Harpe and clasper of male *Leucania fareta*.

27. Harpe and clasper of male *Neleucania bicolorata*.

The characters of *Neleucania niveicosta* and *Neleucania citronella* are very similar.

28. Harpe and clasper of male *Neleucania patricia*.



GENITALIA OF LEUCANIA.

FOR EXPLANATION OF PLATE SEE PAGE 208.

A LIST OF SPIDERS COLLECTED IN ARIZONA BY MESSRS.
SCHWARZ AND BARBER DURING THE SUMMER OF
1901.

By NATHAN BANKS,
Custodian, Section of Arachnida.

During the summer of 1901, Mr. E. A. Schwarz and Mr. H. Barber collected extensively in parts of Arizona, especially in the vicinity of Williams. In the following pages is a list of the Arachnida that they collected. In a previous paper¹ I have reported on a collection made by Mr. Schwarz in southern Arizona. There is, however, very little similarity in these two collections. The one made during the past summer contains a great many northern species; in fact, a large majority of them occur in Colorado.

In this list there are recorded 64 spiders and 13 other arachnids, a total of 77 species. In the previous article there were 55 species, 37 of which are not found in this list; this makes the total number of arachnids recorded from Arizona 114.

Of the spiders in this list the Attidæ are represented by 13 species, the Thomisidæ by 12 species; none of the other families have more than 8 species. Three species are described as new.

This material forms part of the collections of the United States National Museum.

Order ARANEIDA.

Family THERAPHOSIDÆ.

EURYPELMA RUSTICUM Simon.

Eurypelma rusticum SIMON, Act. Soc. Linn. Bord., XLIV, 1892, p. 323.

One female, not quite mature, from Williams, June 2.

Family FILISTATIDÆ.

FILISTATA HIBERNALIS Hentz.

Filistata hibernalis HENTZ, Journ. Bost. Soc. Nat. Hist., IV, 1842, p. 227.

A few specimens from Williams, June 10 and July 1.

¹Proc. U. S. Nat. Mus., XXIII, 1901, pp. 581-590.

Family PHOLCIDÆ.

PSILOCHORUS PULLULUS Hentz.

Pholeus pullulus HENTZ, Journ. Bost. Soc. Nat. Hist., VI, 1850, p. 282.

Several specimens from Williams, July 4, 9-15, and 19. A specimen, June 14, has an egg mass of about 25 eggs, rather loosely attached together.

Family DRASSIDÆ.

DRASSUS COLORADENSIS Emerton.

Drassus coloradensis EMERTON, Bull. U. S. Geol. Surv. Terr., III, Pt. 2, 1877, p. 528.

One female specimen, which I think belongs to this species, from Williams, June 9-15. A figure is given of the vulva.

DRASSODES, sp.

An immature specimen from Williams, June 9-15.

HERPYLLUS ECCLESIASTICUS Hentz.

Herpyllus ecclesiasticus HENTZ, Journ. Bost. Soc. Nat. Hist., V, 1847, p. 455.

A few females from Williams, June 9-15 and May 25.

PROSTHESIMA BARBERI, new species.

Cephalothorax and sternum pale brownish, or rather reddish yellow, darker in front; mandibles red-brown; legs somewhat paler than the cephalothorax; abdomen nearly uniform gray above and below; region of epigynum reddish brown. Cephalothorax not very long but much narrowed in front; mandibles rather prominent; legs somewhat shorter than usual; sternum one and one-fourth longer than broad, broadest at middle, pointed behind; abdomen depressed, truncate at base, with tufts of hairs, one and two-thirds as long as broad, pointed behind; spinnerets prominent. Posterior eye-row nearly straight, but little longer than anterior row; posterior middle eyes oval, less than one-half their diameter apart, fully diameter from rather larger posterior side eyes; anterior middle eyes smaller, about diameter apart, not so far from the large anterior side eyes, which are about their diameter from the equal posterior side eyes; quadrangle of middle eyes higher than broad and broader behind than in front; no spurs under tibiæ I and II, a pair toward base on these metatarsi.

Length, 6 mm.

Several specimens, Williams, in May and June, and Winslow, July 21. One, May 29, has an egg-cocoon, which is of the usual shape, with a plain covering, devoid of any foreign substance, and contains about 30 eggs.

PŒCILOCHROA MONTANA Emerton.

Pœcilochroa montana EMERTON, Trans. Conn. Acad., VIII, 1890, p. 11.

One female from Bright Angel, August 10.

GRAPHOSA CONSPERSA Thorell.

Graphosa conspersa THORELL, Bull. U. S. Geol. Surv. Terr., III, Pt. 2, 1877, p. 489.

One immature specimen from Williams, July 23, evidently belongs to this common northern species.

MICARIA, sp.

An immature specimen from Winslow, July 31, is quite possibly an undescribed species.

Family **CLUBIONIDÆ**.**CHIRACANTHIUM INCLUSUM** Hentz.

Clubiona inclusa HENTZ, Journ. Bost. Soc. Nat. Hist., V, 1847, p. 451.

Specimens come from Bright Angel, July 13 (Colorado Canyon, 3,500 feet), and Prescott, June 20.

CLUBIONA, sp.

Immature specimens from Williams, June 9–15.

Family **DICTYNIDÆ**.**DICTYNA SUBLATA** Hentz.

Theridium sublatum HENTZ, Journ. Bost. Soc. Nat. Hist., VI, 1850, p. 276.

A few specimens from Williams, June 5.

LETHIA TRIVITTATA Banks.

Lethia trivittata BANKS, Proc. Acad. Nat. Sci. Phila., 1901, p. 577.

A female from Williams, July.

TITANŒCA AMERICANA Emerton.

Titaneœca americana EMERTON, Trans. Conn. Acad., VII, 1888, p. 453.

Specimens from Williams, June 5. It is a northern species, but I have seen specimens from near Las Vegas, New Mexico.

Family **AGALENIDÆ**.**AGALENA NÆVIA** Hentz.

Agalena nœvia HENTZ, Journ. Bost. Soc. Nat. Hist., V, 1847, p. 465.

A few examples from Williams, June 9–15, and July 1. They do not differ from many Eastern specimens.

HAHNIA, sp.

One female from Williams, June 5. It is a small species, with a dark abdomen marked above with four prominent transverse spots, the anterior one interrupted in the middle.

Family THERIDIIDÆ.

LATHRODECTES MACTANS Fabricius.

Arauca mactans FABRICIUS, Entom. Syst., II, 1775, p. 410.

A young specimen from Bright Angel, August 10.

THERIDIUM MURARIUM Emerton.

Theridium murarium EMERTON, Trans. Conn. Acad., VI, 1882, p. 11.

Various specimens from Williams, June 9-15, July 20-27; and Bright Angel, August 10.

LITHYPHANTES COROLLATUS Linnæus.

Arauca corollata LINNÆUS, Syst. Nat., X, 1758, p. 621.

Several specimens from Williams, June 9-15, July 19.

LITHYPHANTES MEDIALIS Banks.

Lithyphantes medialis BANKS, Proc. Cal. Acad. Sci., (3), Zool., I, 1898, p. 240.

A specimen from Prescott, June 20. This species was described from Mexico, and this is the first record of its occurrence in the United States.

STEATODA GRANDIS Banks.

Steatoda grandis BANKS, Proc. Acad. Nat. Sci. Phila., 1901, p. 578.

Specimens from Williams, June 8-15 and July 4.

DIPŒNA NIGRA Emerton.

Steatoda nigra EMERTON, Trans. Conn. Acad., VI, 1882, p. 21.

A female from Williams, July 27.

EURYOPIS FUNEBRIS Hentz.

Theridium funebre HENTZ, Journ. Bost. Soc. Nat. Hist., VI, 1850, p. 276.

Various specimens from Williams, May 25, June 9-15, and July 4, 17, and 19.

ERIGONE, sp.

One female from Williams, May 25. It is pale yellowish, with a gray abdomen, marked behind by pale chevrons.

Family EPEIRIDÆ.

EPEIRA GEMMA McCook.

Epeira gemma McCook, Proc. Acad. Nat. Sci. Phila., 1888, p. 193.

Several females from Williams, May 25, June 9-15, and July 27.

EPEIRA CONCHLEA McCook.

Epeira conchlea McCook, Proc. Acad. Nat. Sci. Phila., 1888, p. 199.

One female from Hot Springs, June 21-28; another from Bright Angel, July 10.

EPEIRA DISPLICATA Hentz.

Epeira displicata HENTZ, Journ. Bost. Soc. Nat. Hist., V, 1847, p. 476.

A female from Williams, July 20-27.

TETRAGNATHA EXTENSA Linnæus.

Araña extensa LINNÆUS, Syst. Nat., XII, 1767, p. 621.

Several specimens from Colorado Canyon, July 13, and Williams, June 9-15.

Family THOMISIDÆ.

XYSTICUS FORMOSUS Banks.

Xysticus formosus BANKS, Proc. Acad. Nat. Sci. Phila., 1892, p. 56.

Specimens from Williams, May 29, June 5, July 1, and Bright Angel, August 10.

XYSTICUS DISCURSANS Keyserling.

Xysticus discursans KEYSERLING, Die Spinn. Amer., I, Latr., 1880, p. 20.

One specimen from Williams, July 1-4.

XYSTICUS BENEFACITOR Keyserling.

Xysticus benefactor KEYSERLING, Die Spinn. Amer., I, Latr., 1880, p. 22.

One pair from Williams, June 5 and July 20.

XYSTICUS LOCUPLES Keyserling.

Xysticus locuples KEYSERLING, Die Spinn. Amer., I, Latr., 1880, p. 24.

Many specimens from Williams, June 9-15, July 5, and Bright Angel, July 10.

MISUMENA DIEGOI Keyserling.

Misumena diegoi KEYSERLING, Verh. zool.-bot. Ges. Wien, 1887, p. 481.

Many specimens from Williams, June 9-15, May 25, and July 23; also from Hot Springs, June 21-28.

MISUMENA GEORGIANA Keyserling.

Misumena georgiana KEYSERLING, Die Spinn. Amer., I, Latr., 1880, p. 86.

Several specimens from Williams, July 27.

CORIARACHNE VERSICOLOR Keyserling.

Coriarachne versicolor KEYSERLING, Die Spinn. Amer., I, Latr., 1880, p. 53.

A few specimens from Williams, June 5, July 1-4, and July 27.

TMARUS CAUDATUS Hentz.

Thomisus caudatus HENTZ, Journ. Bost. Soc. Nat. Hist., V, 1847, p. 447.

Various specimens from Williams, June 5, July 1 and 4; also from Prescott, June 20.

TIBELLUS DUTTONI Hentz.

Thomisus duttoni HENTZ, Journ. Bost. Soc. Nat. Hist., V, 1847, p. 448.

A few specimens from Colorado Canyon, July 13.

THANATUS COLORADENSIS Keyserling.

Thanatus coloradensis KEYSERLING, Die Spinn. Amer., I, Latr., 1880, p. 206.

Several examples from Williams, June 9-15, and Bright Angel, August 10.

PHILODROMUS PRÆLUSTRIS Keyserling.

Philodromus praelustris KEYSERLING, Die Spinn. Amer., I, Latr., 1880, p. 209.

Many specimens from Williams, June 5, July 19; Hot Springs, June 21-28, and Bright Angel, August 10.

PHILODROMUS RUFUS Walckenaer.

Philodromus rufus WALCKENAER, Faune de France, Arach., 1825, p. 91.

A few specimens from Williams, May 25 and June 9-15.

Family SPARASSIDÆ.

OLIOS FASCICULATUS Simon.

Olios fasciculatus SIMON, Act. Soc. Linn. Bord., 1880, p. 87.

One specimen from Hot Springs, June 21-24. Previously known only from the Pacific coast.

Family LYCOSIDÆ.

DOLOMEDES SCRIPTUS Hentz.

Dolomedes scriptus HENTZ, Journ. Bost. Soc. Nat. Hist., V, 1847, p. 189.

One female and a young specimen from Hot Springs, June 27. A common Eastern species.

TROCHOSA CINEREA Fabricius.

Araña cinerea FABRICIUS, Entom. Syst., II, 1793, p. 423.

One specimen from Hot Springs, June 21-28.

TROCHOSA PARVA Banks.

Trochosa parva BANKS, Journ. N. Y. Ent. Soc., 1894, p. 52.

Several specimens from Colorado Canyon, July 13.

LYCOSA SCALARIS Thorell.

Tarentula scalaris THORELL, Bull. U. S. Geog. Surv. Terr., III, Pt. 2, 1877, p. 520.

A couple of specimens from Williams, June 9-15. Very common in Colorado and the Northwest.

LYCOSA, sp.

Two females of a large species, without very distinctive characters, from Williams, May 25 and July 20. It is allied to *L. riparia*, and may be only a form of that species.

PARDOSA STERNALIS Thorell.

Lycosa sternalis THORELL, Bull. U. S. Geog. Surv. Terr., III, Pt. 2, 1877, p. 504.

A few specimens from Williams, June 9-15; Prescott, June 20, and Flagstaff, July 5. A common species in Colorado.

PARDOSA, sp.

A female from Williams, July. Apparently of an undescribed species.

Family OXYOPIDÆ.

OXYOPES COMPACTA Banks.

Oxyopes compacta BANKS, Trans. Amer. Ent. Soc., XXIII, 1896, p. 72.

Various specimens from Williams, June 5; Bright Angel, August 10, and Prescott, June 20. Known previously only from Colorado.

HAMALATIWA GRISEA Keyserling.

Hamalatiwa grisea KEYSERLING, Verh. zool.-bot. Ges. Wien, 1887, p. 457.

Specimens from Hot Springs, June 21-28. Widely distributed in the South.

Family ATTIDÆ.

PHIDIPPUS BICOLOR Keyserling.

Phidippus bicolor KEYSERLING, Verh. zool.-bot. Ges. Wien, 1884, p. 496.

One pair from Williams, July 20 and 26. A common species in the arid region of the West.

PHIDIPPUS, sp.

A mature female from Williams, July 19, catching a *Pieris*; a young specimen from Prescott. A very handsome species which, I think, is as yet undescribed.

COLONUS RETARIUS Hentz.

Atus retarius HENTZ, Journ. Bost. Soc. Nat. Hist., VI, 1850, p. 288.

One young specimen from Hot Springs, January 21-28.

DENDRYPHANTES OCTAVUS Hentz.

Atus octavus HENTZ, Journ. Bost. Soc. Nat. Hist., V, 1847, p. 365.

Several specimens from Williams, June 9-15, July 21, and May 25; also from Prescott, June 20, and Hot Springs, June 21-28.

DENDRYPHANTES, sp.

A few females from Williams, July 9-15.

ASTIA MOROSA Peckham.

Astia morosa PECKHAM, Trans. Wisc. Acad. Sciences, VII, 1888, p. 71.

One female from Williams, July. An uncommon species, and as yet known only from the female.

ERGANE BOREALIS Blackwell.

Salticus borealis BLACKWELL, Ann. Mag. Nat. Hist., XVII, 1846, p. 35.

One female from Williams, July 1-4; a pale specimen.

PELLENES ELEGANS Peckham.

Pellenes elegans PECKHAM, Bull. Wisc. Nat. Hist. Soc., Oct., 1900, p. 220.

Pellenes dolosus PECKHAM, Bull. Wisc. Nat. Hist. Soc., Oct., 1900, p. 222.

Specimens from Hot Springs, June 21-28, and Bright Angel, August 10.

ICIUS SIMILIS Banks.

Icius similis BANKS, Can. Entom., 1895, p. 100.

A young specimen from Prescott, June 20.

ICIUS, sp.

An immature specimen, of a species unknown to me, from Colorado Canyon, July 13.

MARPISSA CALIFORNICA Peckham.

Marptusa californica PECKHAM, Trans. Wisc. Acad. Sciences, VII, 1888, p. 81.

One female from Hot Springs, June 21-28.

MARPISSA ALBOPILOSA, new species.

Cephalothorax black, with a broad area of white hairs, narrowed in front between the anterior middle eyes, where it passes down on the clypeus; a white stripe on the side margins; sternum and coxae reddish, with long white hair. Abdomen black, above with many white hairs, giving it a mottled gray appearance; venter more gray, with many white hairs; legs with black hair above, long white hair beneath and on outer side, shorter, adpressed, elongate, scale-like hair above and on sides, scattered among the other hairs. Cephalothorax long and flat, broadest in the middle, tapering each way; abdomen long and slender, depressed; region of epigynum elevated, corneous, and rugose, displaying two large cavities in the anterior portion. Legs short and stout, the anterior pair especially thickened, the spines few and reduced in size; under tibia I there is but one spine toward tip, two pairs under or rather on the lower sides of metatarsus I; spines on hind legs few, but more slender; sternum narrow, the anterior coxae separated by less than the width of lip.

Length, 6.5 mm.

Two specimens from Williams, in July. A very interesting species of a hoary appearance.

SYNAGELES SCORPIONA Hentz.

Synemosyna scorpiona HENTZ, Journ. Bost. Soc. Nat. Hist., V, 1847, p. 369.

Two specimens from Williams, July 1-4.

Order PHALANGIDA.

Family PHALANGIDÆ.

PROTOLOPHUS TUBERCULATUS Banks.

Protolophus tuberculatus BANKS, Can. Entom., 1893, p. 206.

A few specimens from Williams, June.

LIOBUNUM TOWNSENDI Weed.

Liobunum townsendi WEED, Amer. Nat., 1893, p. 295.

Many specimens from Williams, July 17, 18, 21; also Bright Angel, August 10.

Order SCORPIONIDA.

Family VEJOVIIDÆ.

VEJOVIS BOREUS Girard.

Scorpio boreus GIRARD, Marey's Rept. Expl. Red River, 1854, p. 238.

Several specimens from Williams, May 25, July 9-15; Bright Angel, August 10; Winslow, July 31, and Prescott, June 20.

Order PSEUDOSCORPIONIDA.

Family CHELIFERIDÆ.

CHELIFER SCABRISCULIS Simon.

Chelifer scabrisculis SIMON, Ann. Soc. Ent. France, 1878, p. 154.

Many specimens from Williams, May 25, June 6.

CHELANOPS GROSSUS Banks.

Chernes grossus BANKS, Can. Entom., 1893, p. 65.

Many specimens from Williams, June 9-15, July 7. Some specimens taken in June bear the egg-mass, consisting of about twenty eggs tightly bound together and forming a flattened hemisphere. Two specimens were found under the elytra of a beetle, *Ergates spiculatus*, taken July 17 at Williams.

OLPIUM, sp.

One specimen, of an obscure species; Williams, July.

Order SOLPUGIDA.

Family EREMOBATIDÆ.

EREMOBATES SULFUREUS Simon.

Datames sulfereus SIMON, Ann. Soc. Ent. France (5), IX, 1879, p. 142.

Several specimens from Williams, May 25, June 10; Bright Angel, August 10, and Flagstaff, July 5.

Order ACARINA.

Family RHYNCHOLOPHIDÆ.

RHYNCHOLOPHUS ROBUSTUS Banks.

Rhyncholophus robustus BANKS, Ann. N. Y. Acad. Science, VIII, 1895, p. 432.

Several specimens from Williams, June 9-15; also a number of their eggs.

RHYNCHOLOPHUS MACULATUS Banks.

Rhyncholophus maculatus BANKS, Trans. Amer. Ent. Soc., 1894, p. 217.

A few specimens from Williams, June.

RHYNCHOLOPHUS, sp.

One specimen of a broad, pale yellowish species, from Winslow, July 21.

Family GAMASIDÆ.

GAMASUS, sp.

A few specimens taken at Williams, May 23, in a nest of a *Lasius*.

DISCOPOMA HIRSUTA, new species.

Pale yellowish throughout. Body a little broader than long; convex above; rather broader in front, and slightly pointed behind; its sides almost parallel. Dorsum smooth, quite thickly covered with long, slender, erect hairs. Sternum nearly as wide behind as in front, its surface, as well as that of the ventral plate, very finely granulate. Legs short and stout, of usual shape, provided with a few hairs.

Length, 0.62 mm.

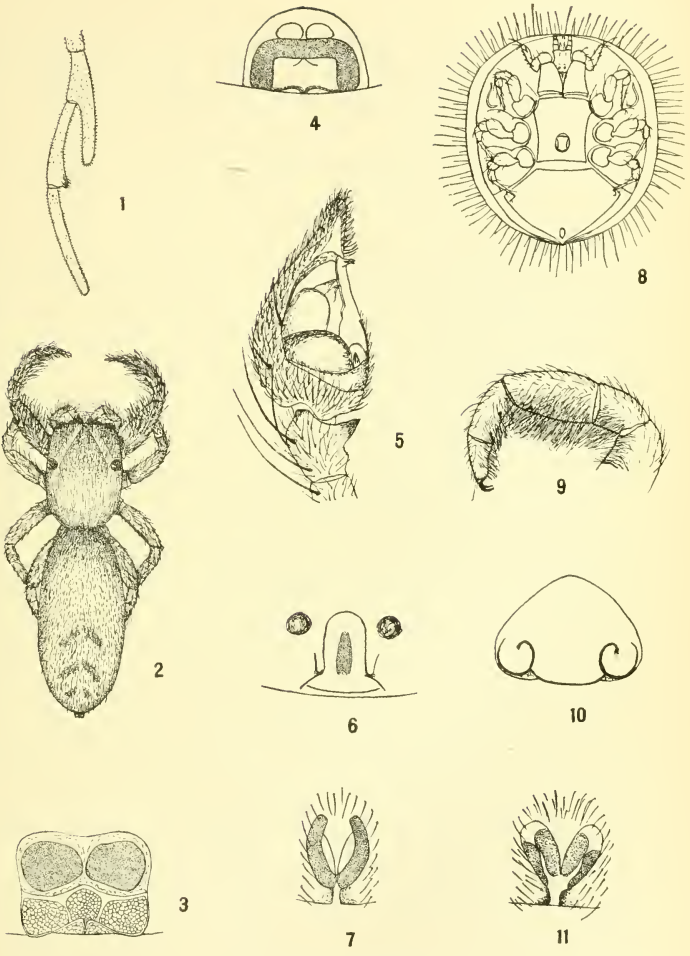
Taken at Williams June 1, with a species of *Lasius*. It differs from our other species of *Discopoma* (*D. circularis*) in the clothing of long hairs, in its larger size, different shape of the sternum, etc.

DISCOPOMA, sp.

One specimen from Flagstaff, July 4, with a species of *Lasius*. It is dark-colored, plainly longer than broad, and with some short hairs in front.

EXPLANATION OF PLATE VII.

- FIG. 1. *Protolophus tuberculatus*, palpus of female.
2. *Marpissa albopilosa*, dorsal view.
3. *Marpissa albopilosa*, vulva.
4. *Drassus coloradensis*, vulva.
5. *Oxyopes compacta*, palpus.
6. *Oxyopes compacta*, vulva.
7. *Prosthesima barberi*, vulva of small specimen.
8. *Discopoma hirsuta*, ventral view.
9. *Marpissa albopilosa*, leg I.
10. *Trochosa parva*, vulva.
11. *Prosthesima barberi*, vulva of large specimen.



SOME ARIZONA SPIDERS.

FOR EXPLANATION OF PLATE SEE PAGE 221.

OBSERVATIONS ON THE CRUSTACEAN FAUNA OF THE
REGION ABOUT MAMMOTH CAVE, KENTUCKY.

By WILLIAM PERRY HAY,
Howard University, Washington City.

During the month of August, 1901, the writer spent a week at the Mammoth Cave of Kentucky and, through the courtesy of Mr. H. C. Ganter, the manager of the estate, was able to make fairly complete collections of the invertebrates, both within the cave and in various neighboring springs and streams. As the object of the visit was to obtain extensive series of the crustaceans of the region, and to record observations on their habits, very little attention was paid to other groups, and aside from the crustaceans the collections were very meager. A few specimens of an earthworm resembling *Lumbricus*, a quantity of fresh-water sponge taken from the rocks well within the exit of Echo River, and one or two specimens of *Cottus* sp. (*richardsoni*?) taken in Roaring River are the only ones worthy of note.

As is well known, the Mammoth Cave of Kentucky has been the subject of many articles long and short, or volumes, which have appeared from time to time. Its fauna has been studied more carefully and by more naturalists than that of any other American cavern, as numerous lists and papers will testify.

The localities given in the present paper are often those within the cave, but the name by which the particular spot is known is usually given for the sake of accuracy. Richardson's Spring is a small pool of clear water supplied by a very small trickling stream and is about 1 mile from the entrance. Roaring River, a passage which is never visited except by the collector, is reached by a low and very muddy and difficult passage which turns off from the main route a short distance beyond Echo River. The mouth of the passage is said to be 2 miles from the entrance of the cave. At times of high water the entire passage, as well as contiguous portions of the main cave, are flooded, but usually the water is confined to a series of small pools among the rocks and mud of the floor of the passage and the stream at the end. Roaring River itself is a stream some 15 or 20 feet wide,

and an average depth of 1 foot. It flows with a steady current and is known to be a part of Echo River.

All the specimens upon which this paper is based have been deposited in the United States National Museum.

Suborder AMPHIPODA.

Family GAMMARIDÆ.

GAMMARUS PROPINQUUS, new species.

Type.—No. 25545, U.S.N.M. Collected by W. P. Hay, August 28, 1901, from a spring about 2 miles north of Mammoth Cave, Kentucky.

Description.—Similar to *Gammarus fasciatus* Say, but with the following characters:

First pair of antennæ less than half as long as the body, the flagellum with about twenty-five segments, the accessory branch much shorter than either segment of the peduncle and composed of but two or three segments.

Second antennæ from half to three-fourths as long as the first; the second and third basal segments of about equal length; the flagellum slightly longer than either segment and composed of twelve articles.

First pair of gnathopoda with the inferior margin of the carpus and hand rather densely fringed with hairs, the longest of which are equal to the width of the carpus; hand with the palmar surface very oblique, hardly distinguished from the inferior surface, armed with a few long bristles and short teeth; dactyl much curved.

Second pair of gnathopoda larger, stronger, the palmar surface less oblique, being at an angle of about 50 degrees with the inferior surface; carpus and hand fringed with hairs as in the preceding appendage; dactyl stronger and straight.

Basal segments of the last three pairs of pereopoda lamellar as usual, but with the posterior margin entire and almost unarmed; the succeeding segments more or less armed with hairs and short spines, but nowhere excessively.

Eye elongate, reniform.

Fifth and sixth abdominal segments with median and lateral groups of spines on their posterior margins. Seventh segment with a few scattered spines, apparently not arranged in groups, along the posterior margin.

Telson cleft to its base; each division with the distal extremity armed with a tranverse row of slender spines; outer margin with two rather slender spines.

Remarks.—This species, which appears to be distinct from any hitherto described, was found in small numbers in several localities in the region about Mammoth Cave. The best specimens were obtained

from the type locality and a few good ones were taken at the outlet of Echo River. In color they were a purplish gray. They were hiding under flat rocks in the cold spring water.

CRANGONYX VITREUS Cope.

This species was observed in considerable numbers in Mammoth Cave, both in its type locality, Richardson's Spring, and in the Roaring River district in small pools. When undisturbed it was most often seen resting quietly or walking slowly through the mud on the bottom with the body vertical and half buried in the soft ooze of the surface. As a result of these movements there were innumerable trails running in all directions, but never of a great length, as if the animal, tiring of walking through the mud, had decided to swim to some more remunerative feeding ground. When once disturbed they swam rapidly about, either on their sides or with the back uppermost, or sought safety by lying quietly behind some projecting pebble or mass of earth. It was observed that when concealing themselves they usually lay on one side. Owing to their exceedingly smooth covering and small size they were very difficult to catch.

Suborder ISOPODA.

Family ASELLIDÆ.

MANCASELLUS MACRURUS Harger.

This species was observed in two or three localities. A few specimens were taken in a spring some 2 miles northeast of the hotel. They seemed to be all very small and immature, but on careful examination several of them could be seen carrying eggs.

At the so-called mouths of Echo River, a series of three large springs at the foot of the hill in which the entrance to Mammoth Cave is found, *M. macrurus* was collected in abundance. They were of rather small size but decidedly larger than the specimens taken from the spring mentioned above.

They were usually found clinging to the under side of flat rocks, which lay in shallow water, and until a large number was disturbed by turning over rocks I was not able to observe any of them crawling about. They were living at this place in company with about equal numbers of *Asellus stygius* (Packard). The association seemed indiscriminate, for I could not see that either species was partial to any particular location or condition in the spring.

CÆCIDOTEA STYGIA Packard.

This well-known species was taken in considerable numbers from a small stream in one of the upper levels of Mammoth Cave and was found in smaller numbers in small pools in other parts of the cavern.

It was also found in abundance at the mouth of Echo River, where it was living in company with *M. macrurus* Harger. They were usually found clinging to the stone walls of the pool in which they were living or could be seen slowly walking over the bottom. When disturbed their movements were considerably quickened, but they were unable to move with any great rapidity. If when disturbed they were clinging to the sides of their pool their first effort to escape was by letting go and falling to the bottom; in case the pool was deep this method was quite effectual. When removed from the water they seemed almost absolutely helpless, the weak legs being quite inadequate to the task of dragging along the heavy body.

Suborder MACRURA.

Family ATYIDÆ.

PALÆMONIAS GANTERI Hay.

Type.—No. 27000, U.S.N.M.

A most unexpected find in the Roaring River passage at Mammoth Cave was a small eyeless shrimp, which proves to be a representative of a family hitherto unrecorded from the North American continent.

The discovery was made one morning when I had gone alone into this passage with the intention of collecting as perfect a series as possible of the blind crayfish. A number of large *C. pellucidus* had been secured, and I was endeavoring to find others of smaller size. To this end the bottoms and the water of the clear pools were being examined most carefully. While thus engaged, an object which seemed to be a very small eyeless fish, appeared swimming slowly along near the surface. From the way it moved in attempting to escape capture it became evident that it could not be a fish, and a determined effort was made to secure it. After a most exasperating chase, during which my specimen seemed more than once to have eluded me, it was captured, and I saw immediately that another animal had been added to the fauna of the cave. I then set about finding others, and, knowing what to look for, they were found quite easily. When first seen they were usually resting quietly or were slowly walking on the bottom of the pool, and were as insensible to the glare of my lantern as were the crayfish. They were so transparent that several times they were detected only by their shadows, and even when moving near the surface they were almost invisible. When disturbed they at once left the bottom, and by the rapid strokes of their subabdominal appendages came to the surface, where they remained for some time before sinking again to the bottom. All their movements were unmistakably shrimp-like and very different from those of any of the other crustaceans in the cave. They were very easily captured, either in the net

or by gently slipping my hand beneath them as they swam slowly on the surface; in fact, the latter method was used in nearly every case. Twelve specimens were put with a live eyeless fish into a 3-ounce bottle, tightly corked, and without a change of water carried about in the cave for over four hours; on reaching the hotel most of them were still alive, and the few that were dead seemed to have been killed by the slime from the fish. Five of them lived for over two days in a tumbler of water on the table in my room, where the temperature stood at times as high as 85 degrees.

On reaching Washington a specimen was at once stained, dissected, and mounted, and I found that my shrimp was not only a new species but must stand as a representative of a new genus, to which the name *Palæmonias* was given,¹ with the specific name of *ganteri* in honor of the manager of the cave, Mr. H. C. Ganter, who afforded me the facilities for making my collection.

As the description mentioned was quite brief and unaccompanied by figures and regarded as only a preliminary notice, it seems advisable to introduce here a more detailed account of the characters of this somewhat remarkable species.

The carapace is very thin, delicate, and transparent, in form cylindrical or slightly compressed; the greatest depth is near the posterior end; the anterior border, below the eye, is produced into two spini-form points, the upper of which is the larger; the rostrum is slender and slightly wider near the middle than at the base, the lower margin bears from one to three minute teeth, while on the upper margin there are about thirteen, of which the first two or three are at the very base, almost on the carapace, and are separated by quite an interval from a group of eight or nine near the middle of the rostrum, which in turn are separated by a second small interval from the group near the distal extremity.

The abdomen is compressed, rounded above, and exceeds the cephalothorax in length. The sixth segment is as long as the fourth and fifth combined. The swimmeretts of the first segments are large and thickly fringed with setæ.

¹Proc. Biol. Soc. Washington, XIV, pp. 179-180, Sept. 25, 1901.

PALÆMONIAS, new genus.

Similar to *Pakemonetes* in form and in the absence of a mandibular palpus. Gills four and a rudiment on each side. Rostrum long, slender, and serrate above and below. Antero-lateral margin of carapace with two spines. First two pairs of ambulatory appendages subequal in size and similar in form, chelate and with large bunches of pectinate bristles on the tips of the fingers.* The articulation of the hand with the carpal segment is at a point on the lower surface of the hand some distance from the proximal end, and the prominent knob-like extremity fits when the limb is fully extended, into a broad sinus formed by the margin of a plate-like expansion of the carpus.

The telson is elongate, slightly angulate and bispinose on the outer margin. The extremity is arcuate and bears nine or ten slender spines. The outer blades of the tail fin are narrow and densely fringed with fine hairs; the external one is indistinctly divided near the distal end by a sinuous transverse line, at the outer end of which there is a small spine and at the inner a projecting angle.

The eyestalks are rudimentary, but seem to be considerably more prominent than in such an analogous form as *Cambarus pellucidus*. They are quite short when compared with the rostrum, but are not hidden by it. The distal extremity is without a trace of pigment or of facets and is bluntly conical.



PALEMONIAS GANTERI HAY.

a Right lateral view of type specimen.
 b Left lateral view of carapace.
 c Mandible.
 d Basal segments of first antenna.
 e Basal segments of second antenna.

f Third maxilliped.
 g Second chelate thoracic appendage.
 h Fifth thoracic appendage.
 i Appendage of sixth abdominal appendage.
 k Telson.

The antennules are biflagellate, the flagellæ being of nearly equal length and about as long as the antennæ. The basal segment of the antennule is expanded somewhat so as to present toward the median line a nearly horizontal blade, which at about its middle is extended into a large, strong spine directed in the same line as the remainder of the appendage.

The antennæ are longer than the body, exceeding it by about half its length; they are very slender; the scale is nearly as long as the rostrum, its outer margin concave and terminating in a small spine some distance from the rounded extremity; the second basal segment bears on its outer distal angle a minute slender spine.

The third maxillipeds are pediform and in all but size quite similar to the third, fourth, and fifth walking legs. All these appendages of the thorax bear a filiform exopodite, which is usually at least as long as the combined lengths of the four basal segments of the appendages.

The first and second pairs of pereiopods are so nearly equal in size that it is with great doubt that I venture the statement that the second

pair is the larger. They are probably slightly longer but more slender. The proximal half of the limb presents no unusual characters, but the distal half has the characters peculiar to the Atyidæ. The proximal end of the carpus is slender and subcylindrical, but toward the distal end on the superior surface there appears a thin plate or ridge which gradually increases in height to a point just short of the distal end of the segment. Here it is abruptly excavated so as to present a broad sinus for the reception of the knob-like extremity of the hand. Below this sinus the carpus extends forward a short distance so as to articulate with the ventral surface of the hand and not its proximal end. The hand is subcylindrical, the postarticular portion is rounded, and, as stated above, is intended to fit closely into the sinus in the carpal expansion. The fingers are so curved as to meet only at their tips. They are apparently quite cylindrical and unarmed except at their tips, where they bear each a dense pencil of rather long, stiff, plumose or pectinate hairs. The hands and carpal segments are usually directed downward and backward so as to bring the ventral finger to the lower side, and the degree of motion between the hand and the carpus seems to be very great.

The daetyls of the last three pairs of pereopods are minutely serrate, as are the distal extremities of the antepenultimate segment.

The gills seem to be only four in number, on each side attached to the first four pereopods, but there may be a rudiment on the fifth.

Twelve specimens were secured, varying in length from 14 to 23 mm. from the tips of the rostrum to the end of the telson. In life they were colorless, but in alcohol they are milk white.

When I first described this genus and species I was of the opinion that its affinities were with the Palæmonidæ and the genus *Palæmonetes*, and the name *Palæmonias* was given to call attention to the fact. I had noticed the striking resemblance of the hand and carpal segment of the first two pairs of pereopods to the similar parts of certain of the Atyidæ, but did not consider this a character of sufficient weight to overbalance the striking resemblance to certain of the Palæmonidæ in every other character. I have recently received a letter from Dr. A. E. Ortman, of Princeton University, calling my attention to other characters, and, furthermore, I have been able to secure the description of *Troglocaris schmidti* Dormitzer,¹ and have thereby been forced to reverse my opinion.

Palæmonias should certainly be placed in the family Atyidæ, and is a very close relative of the genus *Xiphocaris*, from which it seems to differ by only one character, namely, the pronounced excavation of the carpal segments. I would not be willing to accept as a good generic character that of rudimentary eyes, as has been done in this family for the genus *Troglocaris*.

¹ *Lotos*, 3d year, 1853, p. 85, pl. III, fig. 1-5.

The figure of *Olophorus americanus* Saussure,¹ however, shows a rather deep excavation of the carpal segments, and if Dr. Ortman is correct² in regarding this the same as *Xiphocaris longata*, the differences between *Palæmonias* and *Xiphocaris* are very slight indeed.

This species is of especial interest, since it has been shown by Dr. Ortman that the Atyidae are extremely archaic fresh-water crustaceans, and that of them the genus *Xiphocaris* is the most primitive. In former times the distribution of *Xiphocaris* was probably far more extensive than it is at the present. To-day but three surviving species are known to science, "one from the fresh waters of the West Indies, another from streams and pools in Indo-Malaysia, and a third from the streams of New Zealand."³ The isolated species, *Palæmonias ganteri* and *Trogolocaris schmidti*, which, as has been pointed out, may prove to be congeneric with *Xiphocaris*, are species which have been left behind in the limestone caverns when the main body of their relatives was swept to the south.

It offers also another proof of the fact that we may look to the limestone caverns of the world for many of the most valuable clues to the relationships of our present surface fauna. There are doubtless many cases in which the extension of habitat to the subterranean retreats has been quite recent; but, in the main, cave-inhabiting animals are of archaic types and date from a time when conditions were more uniform, and consequently faunal differentiations were less marked than at the present day. In support of this statement it will be sufficient to mention the occurrence in Carniola of a subterranean species of crayfish very similar to those occurring to-day in North America, and quite different from those of Europe, and the more recent discovery in Texas of *Typhlomolge*, a genus of blind, cave-inhabiting salamanders, which, so far as it is known, finds its nearest relatives in *Proteus* of Carniola.

Family ASTACIDÆ.

CAMBARUS PELLUCIDUS (Tellkampf).

The "blind crayfish of Mammoth Cave," which is now known to inhabit the subterranean water courses of a considerable portion of Kentucky and Indiana, was collected and observed frequently wherever conditions were favorable. The shallow margins of the "River Styx" and the small pools in the passage to Roaring River afforded me abundant opportunities to study this interesting species. It was no uncommon thing to have several under observation at one time.

When first observed they were usually on the bottom, resting quietly with their legs and antennæ fully extended. Unless they were

¹Mem. Soc. Phys. Hist. Nat. Genève, XIV, Pt. 2, 1858, p. 472, pl. iv, fig. 31.

²Proc. Acad. Nat. Sci. Phila., 1894, p. 400.

³Idem, p. 400.

disturbed they would remain in this position for several minutes, and then with no apparent reason start off at a rapid gait, move to another spot, and take up the same position. While thus resting, the only movement observable was a slight waving to and fro of the antennæ. Sometimes an individual was seen on a submerged rock mass resting in the same way; such individuals appeared to have no difficulty in running rapidly over the rough surfaces. When alarmed in any way, the crayfish would begin to show signs of uneasiness by moving slightly about in various directions, and then dart away, propelled by the vigorous strokes of its tail fin. There seemed to be no ability on the part of the animal to select a safe haven of refuge from a distance, for the flight for safety was apt to end anywhere: the course was usually laid for deeper water, but if a rock or the wall of the pool was encountered the crayfish would quickly conceal itself in a crevice and retreat beyond reach of danger. Several individuals, when repeatedly chased across a small pool, became either too exhausted or too enraged to retreat and showed a readiness to fight by rising high on the front walking legs and waving their chelæ about in the direction of the danger. Their movements were very quick, probably more rapid than those of outside species, and it was difficult to touch their antennæ and escape a nip from their chelæ.

Several specimens were obtained from places where the pools were nearly or quite dried up, and it was observed that in such places the crayfish had dug for itself a hole or had crawled under a stone and was making preparations to remain. They were already in a semi-dormant condition and in a few days would doubtless have died. The tracks of a cave rat, several excavations made by him, and the remains of a crayfish showed that even in the fastnesses of their subterranean home the crayfishes have enemies to which they sometimes fall victims.

It has frequently been stated that disturbing the surface of the water is sufficient to frighten the crayfish. I did not find this to be the case unless the disturbance was great enough to affect not only the surface but the depths of the pools as well. Indeed I have often passed my hand completely around an individual, all ready and alert, and have brought my fingers within half an inch of its body without causing it to show further alarm. The instant it was actually touched either on its long, waving antennæ or on any portion of its body it would dart away.

From all the evidence which could be gathered it seems that in this creature the senses of sight and hearing have entirely disappeared.

At the time of these investigations the interesting article by Prentiss¹ on the otocysts of the crustacea was unknown to me and I was not led to repeat his experiments on the blind crayfish. So far as I am able to determine without careful microscopic examination the otocyst of

¹C. W. Prentiss. The Otocyst of Decapod Crustacea; Its Structure, Development, and Functions. Bull. Mus. Comp. Zool., XXXVI, No. 7. July, 1901.

C. pellucidus is perfectly normal, but it can not be claimed that it is a functional organ of hearing. The powers of equilibration in *C. pellucidus* are in no way inferior to those of the terranean species with well-developed eyes. It seems to me that the removal of the otocysts in such a blind species and the careful study of the animal's powers thereafter would give a basis for very definite conclusions as to their functions.

In a series of twenty specimens collected in the Roaring River passage ten were females, five were males of Form I, and five were males of Form II. One of the males of Form I is quite soft, and I therefore infer that ecdysis occurs in this species at about the same season as in surface-inhabiting species and that copulation takes place early in the fall. Eggs are said to be laid during the winter, but the guides were rather indefinite as to the exact time.

The smallest specimen collected, a female, is 21 mm. in length; it, as well as the next larger one (26 mm.), differs from the adults in having but one lateral thoracic spine. In a specimen 41 mm. in length all the spines above and in front of the lateral spine are developed. In a specimen 36 mm. long, from Echo River, one accessory spine is present just above the lateral spines, and a few minute granules on the sides of the head, in front of the cervical groove, indicate the patch of spines which is to be found in the adult.

CAMBARUS BARTONI TENEBROSUS, new subspecies.

Type.—No. 22346, U.S.N.M. Mammoth Cave, Kentucky. R. E. Call.

Distribution.—Known only from the type locality.

Description.—Compared with the typical *C. bartoni* from the neighborhood of Philadelphia, the carapace is less depressed and with more parallel sides, the areola is longer, the cephalic portion of the carapace is more robust, and the sides of the rostrum are more convergent. The antennae are slender and in length exceed the body. The eyes are reduced in size and the spine armature is much more strongly developed. There is always a small but acute spine on the side of the carapace just behind the cervical groove; the two spines on the upper surface of the distal end of the meros are usually well developed, and the median internal spine of the carpus is large and strong. In addition to these there usually are, in small individuals, well-developed spines at the anterior end of the postorbital ridge and an acute branchiostegian spine. Throughout the entire series examined there is great uniformity in these characters and they contrast nicely with another small series collected from small surface streams in the neighborhood of the cave. In these the antennae are shorter than the body; the lateral spine of the carapace, even in small individuals, is reduced to a very weak and slender point; the spines on

the upper distal portion of the meros are obsolete, and the eyes are normally developed.

The individuals from the cave range in length from 108 mm. to 35 mm., while those from the surface range from 60 mm. to 10 mm.

Remarks.—This form of *C. bartoni*, which appears to be well marked, was found in considerable abundance in Echo River and the River Styx. Ten specimens were collected; one male, Form II, and nine females, two of which carried eggs. In addition to these I have examined a number of specimens from the same localities collected by Dr. R. E. Call and others.

The fact of the existence of crayfish with eyes in Mammoth Cave in company with the eyeless *C. pellucidus* has frequently been mentioned by writers on the cave and its fauna but the eyed species has always been regarded as a transient or accidental form. It has even been supposed¹ that the eyed and eyeless species interbreed so that "the blind form is continually reinforced by new blood from outside the cave." Dr. Walter Faxon, in speaking of this theory,² gives a number of reasons for discarding it, but later in a paragraph on *C. pellucidus testi* Hay, which in its appearance is much more like *C. bartoni* than is *C. pellucidus*, he seems to think that after all such a thing might be possible.³

During the course of some carcinological work the writer had occasion to review the variations of *C. bartoni* and spent over a month in the examination of several hundred specimens and considerable additional data. The trip to Mammoth Cave was made largely for the purpose of studying the relationship of the cave-inhabiting individuals to individuals living on the surface.

As is well known *Cambarus bartoni* Fabricius is a species with a very extensive range and therefore is subject to much variation. Its habits throughout the range are, so far as I know, practically uniform unless conditions are such as to preclude the possibility of following the customary mode of living. It is a frequenter of cool streams where it lives under the flat rocks or in holes which it excavates among the pebbles. It is rarely found in warm streams or ponds, and when it does occur in such situations is extremely apt to show that this unusual habitat has had effect on its structural character. In its effort to secure its favorite conditions of water, temperature, etc., it is led to ascend the streams, and although this ascent is doubtless made slowly and the attempts at ascent are often stopped or seriously checked by extensive rapids or heavy floods, it is nevertheless almost a certainty that through this habit the animal has gone to the very headwaters of many a mountain stream and in favorable seasons has crossed the

¹Shaler, Mem. Bost. Soc. Nat. Hist., II, 1875, pp. 362, 363.

²Mem. Mus. Comp. Zool., X, No. 4, 1885, p. 41.

³Proc. U. S. Nat. Mus., XX, 1898, p. 647.

divide and reached the source of some other streams. As in Virginia, West Virginia, Kentucky, Tennessee, and Indiana many of the small streams have their sources in cave streams it is easy to understand that *C. bartoni* is of common occurrence in the caverns of the region. I have observed and collected the species in several caves in Indiana and Kentucky in company with *C. pellucidus* and have found it abundant in several caves in Virginia and West Virginia where *C. pellucidus* is unknown. In one of the latter caves I collected an albinistic specimen which is quite indistinguishable from others from the same locality now that the alcohol has bleached them, and I have seen similar specimens in localities where there were no caves.

A review of the characters peculiar to *C. bartoni tenebrosus*, for by that name the cave-dwelling form may be distinguished, shows that there is a tendency in them to approach the characteristics of *C. pellucidus*. At first thought it seems as if this might be due to interbreeding, but there are some difficulties in the way of such an explanation. In the first place the species exist in the Mammoth Cave in nearly equal number, and the females of both have been collected while in the egg-bearing state. The ova of *C. bartoni* are large, those of *C. pellucidus* are small, and no variation in the size of the eggs such as would probably result from crossing has been observed. The females of *C. bartoni*, and the males as well, will average much larger than *C. pellucidus* and are reported by the guides to kill and eat the blind species, a habit that, to say the least, would hardly be conducive to extensive crossing of the two species. *Cambarus bartoni* and *C. pellucidus* are perfectly distinct species and could, without much straining of facts, be regarded as generically distinct. The greatest differences are found in the structure of the sexual organs, and in a group which exhibits such marked specific variation in these organs it seems extremely probable that there is a reason for such differences, and that between species so unlike interbreeding would be extremely difficult if not impossible. There are known in the United States three other species of blind cave-inhabiting crayfishes and, while they undoubtedly have acquired their characters independently, they all resemble *C. pellucidus* quite closely. Slenderness of body and appendages, and length of antennae are as characteristic of them as is the loss of eyes and color. They are conditions brought about by their environment. *C. pellucidus* alone is characterized by excessive spininess, which evidently is either a condition inherited from its ancestors or one which has been developed in response to the peculiar conditions obtaining within its habitat. It will be seen, therefore, that *C. bartoni tenebrosus* resembles all the blind species in the reduction in size of the eyes, and the increase in size of the antennae, and the form of the body, moreover there is indication (as shown by its spininess) of its having responded to the peculiar conditions of Mammoth Cave just as *C. pellucidus* has.

These conditions point to the conclusions: First, that *C. bartoni tenebrosus* is a permanent resident of Mammoth Cave; second, that it has lived there long enough to have diverged markedly from its relations on the surface; third, that it has been affected not only by the general spelean conditions, but those peculiar special conditions of Mammoth Cave; fourth, that it is not the ancestral type from which *C. pellucidus* has sprung; fifth, that the two species are probably to a great degree inimical to each other, and, sixth, that the idea that the two species interbreed is an erroneous one.

That specimens have been taken, as I was told at the cave, which were quite white but otherwise like *C. bartoni tenebrosus*, I do not doubt, but I regard such individuals as albinos.

Regarding the relationship of *C. pellucidus testis* Hay, I will say that so far as is known this subspecies is found in a very small area in Indiana at the very northern limits of the range of *C. pellucidus*. *C. bartoni* occurs in the same cave, but it does not resemble the blind species in any way, and has not even characters by which we can mark it as a permanent resident. Were the conditions reversed and *C. bartoni tenebrosus* found anywhere in company with *C. pellucidus testis* there might be some grounds for regarding them both as possible intermediates between *C. pellucidus* and *C. bartoni*, but under conditions as they exist such a view is untenable.

The surface inhabiting individuals of *C. bartoni* from the neighborhood of Mammoth Cave are plainly the stock from which the cave-inhabiting individuals have descended. In proportions of the body, outline, etc., they agree with the cave variety and differ very markedly from the varieties of *C. bartoni* found in Indiana and Tennessee.

CAMBARUS DIOGENES Girard.

In a collection received from Mr. Edward Hawkins, one of the guides at the cave, there were eight specimens of this species, including females and males of both forms. They agree in shape of rostrum and form of chelipeds with specimens from Indiana, the former having thickened and quite strongly converging margins; the chelæ are short and broad and the movable finger is rather deeply excavated at the base.

CAMBARUS PROPINQUUS Girard.

A few small specimens which appear to belong to this species were obtained from pools and shallow channels along Green River.

CAMBARUS RUSTICUS Girard.

A large number of small individuals of this species were collected in Green River between Mammoth Cave and Ganters Cave. Almost all the males were in the second form. They differ from the typical *C. rusticus* slightly in the greater development of spines, those of the

postorbital ridges and sides of the carapace, as well as the lateral spines of the rostrum, being strong and prominent, the branchiostegian spine is small but quite evident, and the tip of the rostrum is not upturned. In one male (Form I) the anterior segment of the telson is trispinose on each side. The excessive spininess is doubtless due to the immaturity of the specimens.

CAMBARUS PUTNAMI Faxon.

This species was found in abundance in the shallow side channels of Green River in company with *C. rusticus*. Only second-form males and females were collected. In the series quite a variation in the form of the rostrum is observable; the margins in some cases being rather strongly convergent, in others nearly parallel. In almost every case the chela of the male have the fingers slightly gaping at the base.

THE OCELOT CATS.

By EDGAR A. MEARNS.

Major and Surgeon, United States Army.

My thanks are due to the authorities of the United States National Museum for collecting and placing at my disposal as many specimens of Ocelots as were obtainable. In addition, through the United States National Museum and the kind offices of Mr. Witmer Stone and the authorities of the Philadelphia Academy of Natural Sciences, and through Dr. J. A. Allen, I have had the Ocelots belonging to the collections of the Philadelphia Academy of Natural Sciences, and the American Museum of Natural History, New York; and, through Dr. C. Hart Merriam, the specimens of *Felis limitis* in the collection of the Biological Survey of the United States Department of Agriculture have been placed in my hands. From this material it has been possible to differentiate five very distinct forms of the Ocelot, unconnected by intermediate individuals in the materials examined. These forms may be identified by means of the following

KEY TO THE AMERICAN OCELOTS.

- a.* Color decidedly grayish. Black markings restricted. Size small or medium.
- b.* Total length less than 1,100 mm. Skull less than 115 mm. in basilar length. Tail plainly ringed with black above, except at base; subterminal black rings about 8. Ground-color uniformly grayish. Audital bulge short and inflated. Inhabits the valley of the Rio Grande of Texas and Mexico.
- Felis limitis* Mearns.
- bb.* Total length more than 1,100 mm. Skull more than 115 mm. in basilar length. Tail irregularly spotted with black above; subterminal black rings about 3. Color grayish, decidedly tinged with tawny on head and neck. Audital bulge elongate. Inhabits Brazil and the northeastern portion of South America *Felis chibigonazon* Griffith.
- aa.* Color decidedly tawny. Black markings extended. Size large.
- c.* Ground-color above, uniformly tawny, tinged with rufous. Spots of upper portion of body all black, not inclosing light areas. Postorbital breadth of skull greater than the length of the nasal bones.
- Felis equatorialis*, new species.
- cc.* Ground-color above, tawny anteriorly, becoming grayish or paler posteriorly. Spots of dorsal region black, inclosing, or partially inclosing, light areas.

- d. Smaller; basilar length of skull of male measuring 120 mm., female 105 mm. Ground-color of upper parts, tawny anteriorly, varying from wood brown to clay color posteriorly. Black markings moderately intense. Inhabits southern Mexico *Felis pardalis* Linnaeus.
- dd. Larger; basilar length of skull of male measuring 130 mm., female 115 mm. Ground-color russet anteriorly, varying from tawny-olive to cream-buff posteriorly. Black markings very intense. Inhabits Central America, *Felis costaricensis*, new species.

It is probable that some of the above forms intergrade, and it is certain that other forms remain to be described. The diversity and close interrelationship of the species and regional forms of Ocelots, together with the lack of adequate material in the hands of any investigator, have given rise to the multiplication of synonyms and misapplication of names to such a degree that the group is now in a state of nomenclatorial confusion. The earlier descriptions were incomplete, especially with regard to the cranial and dental characters, and were frequently based on young individuals, sometimes living ones, and specimens from unknown localities, or of which the sex was unknown. I have little expectation that my efforts to disentangle the intricately involved synonymy of the American Ocelots will be entirely successful. At a later day, when the existing forms shall have been characterized and the investigator can visit the museums of the Old World, carrying with him the necessary materials for comparison with such types as remain, it may become possible to establish more of the early names than I have been able to do. Those which have received attention from me are the following:

Pardalis (Felis). LINNÆUS, 1766. Syst. Nat., 12th ed., I, p. 62, sp. 5 (based primarily on the *Cato-pardus mexicanus* of Hernandez).

This, the earliest available name for an Ocelot, pertains to the species of east-central Mexico.

Mexicana (P[anthera]). OKEN, 1816. Lehrbuch der Naturgeschichte, p. 1054.

Under the genus *Felis*, an Ocelot from Mexico is described which is probably a synonym of *Felis pardalis* Linnaeus. The name is pre-occupied by *Felis mexicana* Desmarest, Nouv. Dict. d'Hist. Nat., VI, 1816, p. 112, applied to the Yagüarundi Cat.¹

Ocelot (Felis). SMITH, 1827. Griffith's Animal Kingdom, II, p. 475. (South America and Mexico.)

Maj. Charles Hamilton Smith described and figured four forms of the Ocelot: Nos. 1, 2, 3, and 4, including the *Felis pardalis* of Linnaeus, which latter Griffith in the fifth volume of the same work identifies with the Ocelot No. 4 of Smith. Griffith (Vol. V, p. 167) gives the new name *chibiquazon* to Smith's Ocelot No. 1, thus restricting *ocelot*

¹*Felis mexicana* Sanssure, 1860, p. 1, is the Tiger-Cat of Mexico; and *Panthera mexicana* Fitzinger, Sitzungsber., Akad. Wiss. Wien, LIX, 1869, p. 1260, is the Ocelot No. 1 of Major Smith.

to Nos. 2 and 3, of which No. 2 came from South America and No. 3 from Mexico. In 1838 Swainson named the Mexican "Ocelot No. 3" *Felis canescens*, which finally restricted the name *ocelot* to Smith's "Ocelot No. 2." As numerous names have been applied to the four forms which Major Smith figured as Nos. 1, 2, 3, and 4, and described, successively, under the name *Felis ocelot*, a statement of the earliest available name for each is given, as follows:

<i>Felis ocelot</i> Smith	{	Ocelot No. 1.	} From South America.	{	No. 1. <i>Felis chibigouazou</i>
		Ocelot No. 2.		} Griffith, 1827.	
	{	Ocelot No. 3.	} From Mexico -----	{	No. 2. <i>Felis ocelot</i> Smith,
		Ocelot No. 4.		} 1827.	
				{	No. 3. <i>Felis canescens</i> Swainson, 1838.
				}	No. 4. <i>Felis pardalis</i> Linnaeus, 1766.

The name *Felis ocelot* is thus restricted by elimination to the form "Ocelot No. 2." If identical with the Chibigouazou of Azara, from Paraguay, as surmised by Major Smith, it belongs to a form not represented in the collections which I have examined, and is probably entitled to recognition, as Smith's figure of his Ocelot No. 2 is unlike the Brazilian specimens seen by me.

Catenata (Felis). SMITH, 1827. Griffith's Animal Kingdom, II, p. 478, pl.

The author (Smith) had seen two specimens. This Ocelot was supposed by some writers to have come from Mexico, although Swainson gives the following:¹

Major Smith was the first naturalist who made us acquainted with this very elegant ocelot, which had probably been in some of our menageries unknown to science, and subsequently found its way into Bullock's Museum, where this acute observer detected it. He also met with another specimen in the Berlin Museum, and made it known to the Prussian professors.

I am unable to identify this animal. It may have been the young of *Felis pardalis* Linnaeus, although the describer states that the teeth showed it to be adult.

Chibigouazou (Felis). GRIFFITH, 1827. Animal Kingdom, V, 167, No. 431.

This is the "Felis Ocelot No. 1" of Maj. Charles Hamilton Smith. It is the earliest available name for the Ocelot which I have redescribed from Chapada, Brazil, with which Smith's plate figure and description closely agree.

Brasiliensis (Felis). FR. CUVIER, 1828. Nat. Hist. Mamm., July, 1828, pl. LVIII.

Described from a caged specimen from the island of Cuba, supposed to have been brought there on shipboard from Brazil. Probably identical with *Felis chibigouazou* Griffith. Name preoccupied by *Felis brasiliensis* Schinz. Thierreich, 1821, applied to the Black Jaguar.

¹ Animals in Menageries, 1838, p. 125, fig. 19.

Armillata (Felis). FR. CUVIER, 1832. Hist. Nat. Mamm., II, January, 1832, pl. CXXXII.

The figure resembles the Brazilian Ocelot, but no locality is given. The specimen was living in the menagerie of the Jardin des Plantes.

Canescens (Felis). SWAINSON, 1838. Animals in Menageries, p. 118, fig. 16.

This is Ocelot No. 3 of Maj. Charles Hamilton Smith, who observes: "A young female of this is now in Mr. Bullock's Mexican collection. It came from Mexico. I have examined five or six specimens, and believe I have sufficient grounds for considering the differences between this and the preceding [Ocelot No. 2, from "South America"] not to arise from nonage." Probably composite. If from Mexico, perhaps *Felis pardalis* Linnæus.

Smithii (Felis). SWAINSON, 1838. Animals in Menageries, p. 120, fig. 17.

This is Ocelot No. 2 of Maj. Charles Hamilton Smith. In applying the name *Felis canescens* to Smith's Ocelot No. 3, Swainson had restricted Smith's *Felis ocelot* to No. 2. *Felis smithii* therefore became at once a synonym of *Felis ocelot* Smith.

Maracaya (Felis). WAGNER, 1841. Supplement to Schreber's Saugthiere, II, p. 492. (South America.)

It is the *Felis pardalis* of Wied, Beiträge zur Naturgesch. Bras., II, p. 361. Brazil and Paraguay. Perhaps identical with Azara's Chibigouazou.

Pictus (Leopardus). J. E. GRAY, 1842. Ann. Mag. Nat. Hist., X, p. 260.

A very strongly colored Ocelot which I have not seen; from "Central America." The description, given more in detail in Gray's List of Mammals in the British Museum, 1843, p. 43, and especially in the Proceedings of the Zoological Society of London for the year 1867, p. 271, does not agree with the Ocelot which I have named *Felis costaricensis*.

Griseus (Leopardus). J. E. GRAY, 1842. Ann. Mag. Nat. Hist., X, 1842, p. 260 ("Hab. Central America. Both varieties in Brit. Mus.")

Later, Gray stated that it came from Guatemala. I am unable to identify it with any of the forms which I have examined.

Pseudopardalis (Felis). BOITARD, 1842. Le Jardin des Plantes description et moeurs des Mammifères, etc., p. 187.

Supposed to inhabit Mexico and the Bay of Campeche. Apparently a synonym of *Felis pardalis* Linnæus.

Melanura (Felis). BALL, 1844. Proc. Zool. Soc., p. 128.

Undeterminable; described from a living specimen from an unknown locality.

Albescens (Felis) PUCHERAN, 1855. Voyage Vénus, Zool., text p. 137, atlas pl. VIII.

A translation contains the following:

As to the individual which we have described, it was a male, from the State of Arkansas, in Louisiana, which had been given to our menagerie by M. Trudau. Nothing proves to us that this species inhabits Brazil, and as the application of the name cited above [*Felis brasiliensis* Fr. Cuvier] carries with it an error, we think it legitimate, until we have further information, to substitute for it the denomination Albescens Cat (*Felis albescens*), a name which recalls to memory the whitish tint of the pelage.

It thus became a synonym of *Felis brasiliensis* Fr. Cuvier, 1828.

Minimus (*Felis pardalis*). WILSON, 1860. Proc. Acad. Nat. Sci. Phila., p. 82.

Unidentifiable. "It was obtained in Realejo, Nicaragua, in the month of December, 1858. At that time it was too young to eat anything except milk."

Pardoides (*Felis*). J. E. GRAY, 1867. Proc. Zool. Soc. London, p. 403; Cat. Carn. Mamm., 1869, p. 20, sp. 5. (Tropical America.)

Unidentifiable.

Ludoviciana (*Panthera*). FITZINGER, 1869. Sitzungsber. Akad. Wiss. Wien, LIX, p. 258.

An unidentifiable composite, based on a miscellaneous compilation.¹

Jardinii (*Panthera*). FITZINGER, 1869. Sitzungsber. Akad. Wiss. Wien, LIX, p. 263.

This is the *Felis pardalis* of Jardine,² which can not be positively identified.

Hamiltonii (*Panthera*). FITZINGER, 1869. Sitzungsber. Akad. Wiss. Wien, LIX, p. 265.

This is the Ocelot No. 2 of Major Smith, in Griffith's Animal Kingdom, II. 1827, p. 476, from South America.

Griffithii (*Panthera*). FITZINGER, 1869. Sitzungsber. Akad. Wiss. Wien, LIX, p. 266.

This is Major Smith's Ocelot No. 3, from Mexico. Perhaps identical with *Felis pardalis* Linnæus.

Limitis (*Felis*). MEARNS, 1901. Proc. Biol. Soc. Washington, XIV, Aug. 9, 1901, p. 146. (Brownsville, Cameron County, Texas.)

See below.

The species which I am able to recognize, at present, are described as follows:

FELIS LIMITIS Mearns.

RIO GRANDE OCELOT.

1855. *Felis albescens* PUCHERAN, Voyage Vénus, Zool., text p. 137; atlas, pl. VIII (= *Felis brasiliensis* Fr. Cuvier). (Perhaps in part, as to menagerie specimen from M. Trudau.)

1901. *Felis limitis* MEARNS, Proc. Biol. Soc. Washington, XIV, p. 146, Aug. 9, 1901.

¹ See Proc. Biol. Soc. Washington, XIV, Aug. 9, 1901, p. 145.

² Mammal., II, pp. 206, 211, 268, pl. xvi.

Type locality.—Brownsville, Cameron County, Texas.

Geographic distribution.—Rio Grande Valley of Mexico and the United States; formerly ranging north to "Arkansaw" and "Louisiana" of the old geographies, but probably not north of Texas and New Mexico at the present time.

General characters.—Smaller and grayer than *Felis pardalis* Linnaeus, with markings less intense, and without strong contrast of coloration between the ground-color inside and outside of the black rings. Skull relatively broad; dentition weaker; interpterygoid fossa wider and more quadrate; audital bullae wider and more inflated; postorbital process more flattened and less depressed.

Color.—Upper parts exquisitely lined and spotted with black on a drab-gray ground. The ground-color varies from whitish drab-gray on the uninclosed areas to pale broccoli brown on those that are inclosed or margined with black. The pattern is never exactly the same on any two specimens, although the general effect is similar. There is a distinct vertebral area marked with black, usually appearing as a more or less broken or irregular line of black on the posterior three-fifths, breaking up into parallel or divergent lines or spots anteriorly; it is usually apparent from the occiput to the root of the tail, though always an interrupted line. In places, especially on the rump, it often becomes a single or double row of black spots, while anteriorly it may change to parallel lines or elongated inclosures. On each side of the vertebral line is a parallel series of inclosed or (occasionally) solid black elongate areas, sometimes containing black spots. Succeeding these, laterally, are series of elongate, partially or completely inclosed spots or irregular bands of drab-gray having a trend downward and backward, and separated from one another by grayish white areas, an especially broad transverse one usually appearing behind the shoulder. Upper side of neck with longitudinal black stripes inclosing drab-gray areas anteriorly and usually open posteriorly. Upper side of head with a broad black, usually interrupted line arising about 10 mm. above the middle of the orbital ring and extending backward on either side to opposite the middle of the ear; between these lateral bands are several interrupted lines of spots, larger behind and breaking up into small spots anteriorly. Eyelids blackish, bordered above and below by whitish bands, succeeded by drab-gray. Side of head with two conspicuous black longitudinal stripes, the upper one beginning as a black spot behind nostril, another in front of inner canthus and involving upper and lower eyelids, extending thence to a point about 30 mm. below and behind the posterior root of the ear; lower stripe, beginning behind whiskers and below middle of orbit, extends backward to behind ear, then transversely across under side of head, almost joining the corresponding stripe of the opposite side. The space between these black lines is

white except anteriorly; that between the upper one and the lateral crown stripe forms a large drab-gray triangle between the eye and ear, in which there are but few small black spots. Muzzle, above plain drab-gray, lined on sides with spots of black edged with drab, and plain grayish white posteriorly. Whiskers mostly white, some becoming brownish black at base. Ear with concavity well coated with whitish buff hairs; convexity black anteriorly, grayish white posteriorly, the latter encroaching on the middle of the black area, forming a rounded spot, which, in one individual, is narrowly encircled by black posteriorly, cutting it off from the whitish posterior third of the ear. Outer surface of limbs transversely spotted with black, the spots decreasing in size from within outward, becoming obsolete on the toes. Under parts white, very slightly tinged with ochraceous, the pelage drab-gray at base; chin and throat, middle of neck, and belly between thighs unspotted. Under side of neck with two transverse bands of black slightly mixed with fulvous, interrupted at median line. Hinder part of neck finely spotted with black; chest and belly coarsely spotted, the black spots rounded on chest and transversely elongated on abdomen. Inner surface of limbs whitish, transversely spotted with black. Under side of feet hair brown, sometimes mixed with hoary. Tail, whitish gray, speckled with black below; upper surface irregularly barred with light and dark bands, the former grayish white, the latter drab gray, edged with black, and somewhat grizzled; light rings, averaging about ten.

Skull and teeth.—Compared with *Felis pardalis* Linnaeus the skull is smaller, relatively short and broad, the interpterygoid fossa averaging considerably wider and more quadrate. The auditory bullae are relatively short, and more inflated than in any other form; and the postorbital processes are more flattened and less depressed. The dentition is relatively weak.

Measurements.—Adult male: Length, 1,080 mm.; tail vertebrae, 330; length of hind foot, 160; ear above crown, 50. Adult female: Length, 950; tail vertebrae, 300; hind foot, 145; ear above crown, 50. Skulls: Greatest diameters of largest male, 140 by 93 (basilar length of Hensel, 114); largest female, 126 by 87. (See table of cranial measurements, p. 249.)

Remarks.—It is uncertain whether the Ocelot referred to by Dr. Richard Harlan and other early writers as occurring in Arkansas and Louisiana was precisely the same as the present form. Harlan¹ observes as follows: "Inhabits Mexico, and the south-western parts of the United States, particularly Louisiana; also observed by Mr. Nuttall in the Arkansa territory; vid. Travels into the Arkansa territory, page 118. Not known to exist east of the Mississippi." Pucheran's colored

¹Description of the Mammiferous Animals Inhabiting North America, 1825, p. 98.

plate of "a male from the State of Arkansas, in Louisiana, which had been given to our menagerie [in Paris] by M. Trudau," shows the ground clay color above, which agrees with *Felis pardalis* but not with *F. limitis*.

FELIS PARDALIS Linnæus.

MEXICAN OCELOT.

1766. *Felis pardalis* LINNÆUS, Syst. Nat., 12th ed., I, p. 62, sp. 5.
 1816. *Felis mexicana* OKEN, Lehrbuch der Naturgeschichte, p. 1054.
 1827. ?*Felis catenata* SMITH, Griffith's Animal Kingdom, II, p. 478, pl.
 1838. ?*Felis canescens* SWAINSON, Animals in Menageries, p. 120, fig. 17.
 1842. ?*Felis pseudopardalis* BOITARD, Le Jardine des Plantes description et moeurs des Mammifères, etc., p. 187.
 1869. ?*Panthera jardiui* FITZINGER, Sitzungsber. Akad. Wiss. Wien, LIX, p. 263.
 1869. ?*Panthera griffithii* FITZINGER, Sitzungsber. Akad. Wiss. Wien, LIX, p. 266.

Type locality.—Mexico.

Geographic distribution.—Southern and eastern Mexico. (It is uncertain whether this form occurs in northwestern Mexico.)

General characters.—Decidedly larger than *Felis limitis*. Ears large. Black markings extended. The ground-color within the black circles contrasts strongly with that outside of them; and the chains of black-bordered inclosures are broken up into patches, which commonly contain black spots. The skull is relatively narrow; dentition heavy.

Color.—There are three principal colors—black markings, ground-color outside the black circles, and color within the circles. The general ground is pale grayish buff; within the black rings, dark clay color. The pattern of the black markings is similar to *Felis limitis*, differing in having the chains of black-edged inclosures broken up into shorter patches, and the longitudinal black neck-stripes more frequently double, inclosing clay-colored stripes. On the fore limbs the black markings are disposed in irregular rosettes or rounded spots, while in *F. limitis* they tend to form transverse bands. The tail-rings contain irregular areas of russet. The gray ear spot is small, and barely reaches the edge of the ear; and there is no distinctly grayish area bordering the posterior margin of the ear, as there is in *limitis*. The coloration as a whole is more intense.

Skull and teeth.—See measurements.

Measurements.—I have no reliable external measurements of fresh specimens. Skulls—Largest male: Basilar length (Hensel), 122; zygomatic breadth, 91. Largest female: Basilar length, 102; zygomatic breadth, 87. (See table of cranial measurements, p. 249.)

Remarks.—Skins, unaccompanied by skulls, in the collection of the American Museum of Natural History in New York—one from Arizona, one from Sonora, and two from the State of Colima, Mexico (the

latter collected by Dr. Buller)—are of a peculiar pattern and grayish coloration, quite different from either *limitis* or *pardalis*; but, in the absence of skulls, the form can not be differentiated.

FELIS COSTARICENSIS, new species.

COSTA RICAN OCELOT.

Type.—Skull No. 14180, U.S.N.M. Adult male from Talamanca, Costa Rica; collected by William M. Gabb. (The skin, No. 12180, U.S.N.M., seems to have been destroyed.)

General characters.—Size very large. Ground-color decidedly tawny. Black markings extended and very intense. Ear smaller than in *Felis limitis*. Skull narrow, osseous, with a heavy dental armature.

Color.—Pattern similar to that of *Felis pardalis* and *F. limitis*. Coloration like that of *F. pardalis*, but with black markings increased in area and intensity. Neck with median pair of black stripes consolidated, so there are but five longitudinal stripes on upper side of neck. Ears black, with the gray patch extending to margin and measuring 8 by 25 mm. Upper parts with ground-color russet, becoming tawny-olive on the inclosed areas of the spots, and cream-buff between the chains of spots on the sides. A heavy black stripe, 250 mm. in length, occupies the median dorsal area, the row of spots on either side being solidly black, elliptical, measuring about 15 by 20 mm. The lateral-dorsal spots all heavily inclose areas of tawny-olive, except anteriorly, where they are sometimes open (C-shaped), the spots being 20 to 40 mm. in length and half as wide, varying in size and shape within the usual limits. Tail with more black than light; about eleven crossbars of black, encircling the tail more narrowly below than above. A broad collar of black crosses the under side of the head behind the throat, and the pectoral collar is likewise continuous. The under parts are cream-buff, with the usual black spotting, the largest blotches on the chest measuring 25 mm. in greatest diameter. The russet ground-color of the upper parts becomes less intense posteriorly, but much less markedly so than in the Brazilian Ocelot, which also differs in having most of the lateral spots C- or <-shaped, open anteriorly.

Skull and teeth.—Skull narrow, but heavily ossified, with prominent crests and terete, elongate, depressed postorbital processes. The braincase is narrow; dentition heavy.

Measurements (adult female, No. $\frac{1}{4}$ $\frac{2}{11}$ $\frac{1}{8}$, U.S.N.M., from Talamanca, Costa Rica, collected by William M. Gabb; now No. 2853 in the collection of the Philadelphia Academy of Natural Sciences, on which the above description of the color is based).—Length (of skin), 1,050 mm.; tail, 280; hind foot, 162. Skull (largest male): Basilar length (Hensel), 134; zygomatic breadth, 108. Largest female: Basilar length, 112; zygomatic breadth, 92.

Remarks.—This is the largest North American Ocelot. Quite singularly, the smallest of the Jaguars (*Felis centralis*) occurs in the same region. Alston observes:¹ "In Costa Rica, where it is called Manigorda (literally, *fat paws*), Dr. v. Frantzius says that, in spite of its smaller size, it is as much dreaded as the Jaguar."

FELIS CHIBIGOUAZOU Griffith.

BRAZILIAN OCELOT.

1827. *Felis ocelot* SMITH, Griffith's Animal Kingdom, II, p. 475. (Part; as to Ocelot No. 1.)

1827. *Felis chibigouazou* GRIFFITH, Animal Kingdom, V, p. 167, No. 431.

1828. *Felis brasiliensis* FR. CUVIER, Hist. Nat. Mamm., July, 1828, pl. LVIII (not *Felis brasiliensis* Schinz, 1821).

1832. *Felis armillatus* FR. CUVIER, Hist. Nat. Mamm., II, January, 1832, pl. CXXXII.

Type locality.—South America.

Geographic distribution.—Brazil and northeastern South America.

General characters.—Size medium. Coloration pale; ground-color fulvous anteriorly, grayish posteriorly. The skull most resembles that of *Felis pardalis* Linnaeus.

Color.—Pattern as in the preceding species, but with the black markings everywhere restricted. Ground-color tawny anteriorly, fading to grayish posteriorly, or light clay color in the black-bordered spots, which are usually open anteriorly. The ground-color within the black-bordered chains of spots is decidedly darker than that between them; and a similar contrast is afforded by the coloration of the anterior and posterior portions of the upper parts of the animal. The tail is very irregularly spotted with black above, with only about three distinct subterminal rings.

Skull and teeth.—The skull and braincase are narrow, the teeth large, and the audital bullæ elongate. (See table of cranial measurements.)

Measurements.—Adult male (skin): Length, 1,150 mm.; tail vertebrae, 340; length of hind foot, 160; ear above crown, 50. Skull (adult male): Basilar length, 125; zygomatic breadth, 100. Largest female: Basilar length, 105; zygomatic breadth, 93.

Remarks.—In the South American Ocelots the gray patch on the back of the ear is usually surrounded by black, narrowly at edge of ear; but in North American Ocelots the gray spot usually extends to the margin of the ear, in *F. limitis* often cutting off the posterior horn of the black crescent.

FELIS ÆQUATORIALIS, new species.

ECUADOR OCELOT; TIGRILLO.

Type.—No. 113267, U.S.N.M. Adult female, collected at Paramba, northern Ecuador (altitude 3,500 feet), November 2, 1899, by G. Fleming. (Original number, 22.)

¹ Biologia Centrali-Americana, Mammalia, 1879-1882, p. 60.

General characters.—Size very large. Ground-color tawny-rufous. Spots of upper parts all black, not inclosing lighter areas. Postorbital breadth of skull greater than length of nasals.

Color.—The type (November) is heavily marked with black on a ground of tawny above and smoke gray below. Upper parts tawny, tinged with rufous, of almost uniform intensity. Black pattern similar to that of *Felis pardalis* Linnaeus, except for its greater intensity. The black markings only inclose light areas upon the sides, where the inclosed areas are much smaller and very much less elongated, bearing, in fact, a close resemblance to the pattern of *Felis onca*. Upper side of neck with six longitudinal stripes, beginning between the ears and ending in front of the shoulders. The stripes forming the middle pair are nearly parallel, about 4 mm. wide and 5 to 10 mm. apart; those of the next pair begin 20 mm. apart and (in the skin) end 55 mm. apart, having a width of 5 mm. anteriorly and about 15 posteriorly. The outer stripes begin 10 mm. internal to the ear, pass downward and outward to the median outer side of the neck, having a pretty uniform width of about 5 mm., except where narrowly bifurcating posteriorly. Four irregular rows of solid, glossy-black spots extend from the shoulders to the hips; these are mostly elongate, from 5 to 15 mm. in width and 10 to 60 mm. in length. The oblique area of light bordered with black between hips and shoulders, and the transverse black stripes at the shoulders (characteristic of *Felis pardalis*) are not plainly indicated, but, instead, are broken up into spots which even form rosettes. On the outer faces of the fore and hind limbs the tawny color becomes slightly paler, and grayish on the feet. On the fore limbs the black spots are rounded, and decrease from above downward, ranging from 3 to 18 mm. in diameter; the same being the case on the hind limbs, where the spots vary from 3 to 25 mm. in diameter. The tail is reddish tawny above, irregularly spotted with black on basal three-fifths, with five transverse subterminal black bands on last two-fifths, the last three forming continuous rings around the tail. The widest tail-ring is 40 mm. in width. Inner surface of ear light tawny; outer surface black, inclosing a rectangular gray spot measuring 13 by 18 mm. Top of head with two parallel, black, longitudinal stripes, about 5 mm. in width and 40 mm. apart, extending from above the inner canthus of the eye to opposite the front of the ears. Space between the stripes, and between the ears, spotted with black; in all about forty spots, varying from 3 to 10 mm. in greatest diameter. Side of head with two heavy black stripes, each about 7 mm. in width, the upper beginning at the outer canthus of the eye, the inner midway between the last point and the margin of the upper lip, these two ending separately at side of neck below and behind ear. The large triangular space between the black crown-stripe and the upper lateral stripe is unspotted. On either side of underpart of the neck is a black spot,

shaped like a riding boot with the heel pointed toward the end of the lower jaw, the toes separated by a space of 30 mm. in the median line. Chin and throat buffy-white. Side of neck with a longitudinal black stripe 70 mm. in length and 10 mm. in width. Under surfaces and inner sides of limbs smoke gray. There is a very faint buffy-gray pectoral collar, interruptedly bordered with black anteriorly. Underparts spotted with black, sparingly on neck, axillae, and hollows of thighs; most thickly and heavily blotched with black on chest, where the spots vary in size from small dots to blotches 40 mm. in diameter. Underside of tail grayish buff, irregularly cross-banded with black; tipped slightly with gray. Eye-ring and crescentic area at either side of nose, black. Whiskers mixed black and white. Five transverse lines of black spots border the lip on each side of the nasal pad. Muzzle above, plain tawny.

Skull and teeth.—This species and *Felis limitis* have the braincase unusually broad. *Limitis* is at once distinguished by small size (less than 115 mm. in basilar length). The measurements of the type and only specimen are given in the appended table of cranial measurements.

Measurements of type (adult female).—Head and body, 725 mm.; tail, 366; hind foot, 150; ear from crown, 55.¹ Skull: basilar length, 113; zygomatic breadth, 95.

Remarks.—The coat is fuller and softer than that of *Felis pardalis* or *F. limitis*; and it also differs from them in lacking a complete black pectoral collar and transverse black band back of the throat.

Note.—In conclusion I must express my obligation to Mr. Outram Bangs, curator of mammals at the Museum of Comparative Zoology at Cambridge, Mass., for the generous offer of the Ocelots at his disposal, including a number collected at his personal expense in Central and South America. Unfortunately this highly important material was not available until the assembled specimens had been returned to the several museums, and I was preparing for a new military station in the West.

¹The preceding measurements were taken fresh by the collector.

A REVIEW OF THE TRIGGER-FISHES, FILE-FISHES, AND TRUNK-FISHES OF JAPAN.

By DAVID STARR JORDAN and HENRY W. FOWLER,
Of the Leland Stanford Junior University.

In the present paper is given an account of the Plectognathous fishes, found in Japan, belonging to the suborders of Sclerodermi and Ostracodermi. The paper is based on the collections made by Jordan and Snyder in 1900, and on the material contained in the United States National Museum, and collections made by the United States Fish Commission steamer *Albatross*.

SCLERODERMI.

Sclerodermi may be defined as Plectognathous fishes with a spinous dorsal composed of one or more spines inserted just behind the cranium; body of the normal fish-like shape; scales rough, or spinigèrous, of regular form; jaws with distinct teeth, conical or incisor-like.

(σκληρός, hard; δέρμα, skin.)

ANALYSIS OF FAMILIES.

- a. Ventral fins represented each by a large spine, normally articulating with the pelvic bones; scales rounded, more or less spinigerous; dorsal fin of 3 to 6 spines; vertebrae about 19 TRIACANTHIDÆ, I.
- aa. Ventral fins obsolete, or the pair represented by a single spine at the end of the long pelvic bone; scales rough, rhombic, or spiniform.
- b. Vertebrae in small number, 17 to 21; no barbel at chin; gill opening not before the eyes.
- c. First dorsal composed of 3, rarely 2, spines; the first spine very large, the second locking it in erection; scales comparatively large, bony, rough, forming a coat of mail; vertebrae, 17 BALISTIDÆ, II.
- cc. First dorsal of a single spine, with a rudiment at its base; scales minute, not bony, the edges spinescent, so that the surface of the body is rough velvety; vertebrae, 18 to 21 MONACANTHIDÆ, III.

Family I. TRIACANTHIDÆ.

Body compressed, covered with small or minute rounded scales more or less spinigerous. Mouth small; teeth in 1 or 2 series in each jaw, conical or incisor-like. First dorsal fin of 3 to 6 strong spines, the

first one largest; soft dorsal rather long and low, similar to anal; ventral fins each a strong spine attached to the pelvic bone; vertebrae (in *Triacanthus*) $9+10=19$. Three genera and about 5 species; tropical shore fishes, chiefly East Indian, one of them American.

- a. *Triacanthodinae*: Teeth small, close-set, conical, not incisor-like; caudal peduncle short; dorsal spines strong, not very unequal.
- b. Teeth in two rows in each jaw, the upper jaw with about 14 teeth in the outer row, the lower with 22; inner series with about 2 teeth. . . . *Triacanthodes*, 1.
- aa. *Triacanthinae*: Teeth incisor-like, in two series in each jaw, those of the outer row prolonged, about 10 in number, the inner series with 2 or 4; caudal peduncle produced, slender; first dorsal with 3 or 4 small spines behind a very large one. *Triacanthus*, 2.

1. TRIACANTHODES Bleeker.

Triacanthodes BLEEKER, Act. Soc. Sci. Indo. Nederl., III, 1857, Japan, IV, p. 37 (*anomalus*.)

Body short, compressed, with short tail, covered with small spiny scales; teeth small, conical, close set, in two series, about 14 to 22, two small teeth in the inner series. Lateral line inconspicuous. Dorsal spines about 5, strong, not very unequal, rough on their basal halves. Ventrals each a strong spine attached to the pelvic bone, besides two slender soft rays. Soft dorsal of about 15 rays; anal of about 12.

(*triacanthus*: εἶδος, resemblance.)

1. TRIACANTHODES ANOMALUS (Schlegel).

BENI KAWAMUKI (RED FILE FISH).

Triacanthus anomalus SCHLEGEL, Fauna Japonica Poiss., 1846, p. 295, pl. CXXIX, fig. 3; Nagasaki.—NYSTROM, Svensk. Vet. Ak., 1887, p. 47; Nagasaki.

Triacanthodes anomalus BLEEKER, Act. Soc. Sci. Indo. Nederl., III, 1857, Japan, IV, p. 37; Nagasaki.—GÜNTHER, Cat. Fish., VIII, 1870, p. 208; Japan.

Depth $2\frac{1}{3}$; head little over 3 (4 in total); D. IV to VI, 14 to 16; A. 12 to 13; V. I, 2. Snout $2\frac{1}{2}$ in head. Jaws with a single series of from 18 to 20 small teeth, pointed, somewhat conical and curved. Body compressed and roughened. Pectorals rounded, $1\frac{2}{3}$ in head. First dorsal spine almost as long as the head. Dorsal and ventral spines strong, rough on their basal halves. Ventral spines roughened and as long as the first dorsal spine. Anal beginning a little behind anus and its height equal to a fifth of the depth of the body. Second dorsal larger than anal and its height 3 in the depth of the body. Caudal rounded and equal to the snout with eye. Color reddish, brighter above and whitish below. Length 3 to $4\frac{1}{2}$ inches. (Schlegel, Bleeker, Günther.)

This little fish, which reaches a length of 4 or 5 inches, is recorded by Schlegel as taken only in May about the rocks at the mouth of the

bay of Nagasaki. It is much valued as a food fish and is eaten raw with a sauce of *sake* or rice brandy. No specimens were taken by Jordan and Snyder.

(*anomalous*, anomalous.)

2. TRIACANTHUS Cuvier.

Triacanthus CUVIER, Règne Animal, 1st ed., 1817, p. 152 (*biaculeatus*).

Body more or less elongate, compressed, covered with minute rough scales; tail slender, prolonged; teeth in two series in each jaw; those of the outer row incisor-like, ten in number, those of the inner row more rounded, two or four in number. First dorsal of one very strong rough spine and several short ones. Ventral fins each of a strong spine attached to the pubic bone; soft dorsal of about 24 rays, anal of about 19; lateral line conspicuous.

(*τρεις*, three; *ἄκανθα*, spine.)

2. TRIACANTHUS BREVIROSTRIS Schlegel.

GIN-KAWAMUKI (SILVERY FILEFISH).

Triacanthus brevirostris SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 294, pl. CXXIX, fig. 2; Nagasaki.—HOLLARD, Ann. Sci. Nat., I, 1854, p. 45, pl. II, fig. 1.—BLEEKER, Atlas Ichth. Balist., 1865-69, pl. XVII, fig. 3; Java, Madura, Sumatra, Singapore, Borneo, Celebes, Amboyna, etc.—GÜNTHER, Cat. Fish., VIII, 1870, p. 209; Japan, Formosa, Amboyna, Madras, China.—ISHIKAWA, Prel. Cat., 1897, p. 4; Kagoshima, Suruga.

Triacanthus rhodopterus BLEEKER, Verh. Bat. Gen., XXII, 1849, p. 25, pl. IV, fig. 8.

Triacanthus russelli BLEEKER, Verh. Bat. Gen., XXII, 1849, p. 25; Coromandel (after Patrick Russell).

Triacanthus brachyponna BLEEKER, Nat. Tyds. Ned. Ind., IV, 1853, p. 128.

Balistes bipes GRONOW, Cat. Fish., Ed. Gray, 1854, p. 37; East Indies.

Head about 4; depth 2 to $2\frac{3}{8}$; snout $1\frac{1}{2}$, and eye 3 to 4 in head; D. V, 22 to 25; A. 17 to 20. Maxillary 10 in external series, incised or cuneiform, and inner series obtusely rotundate. Snout not produced, with the upper profile nearly straight. Pectorals rounded, short. First dorsal spine strong, covered with asperities; ventral spines long. Second dorsal a little lower than the longest anal ray. Color above greenish or bluish gray, below silvery or yellowish; head above, greenish; spinous dorsal with a black blotch. Length, 11 inches. (Schlegel, Bleeker, Günther.)

Bleeker regards *Triacanthus nieuhoffi* with a depth of 2 to 3 (total length) as distinct from *Triacanthus brevirostris*, which has a depth of 3 to $3\frac{1}{2}$ (total length).

This species, common in the East Indies, is rare in Japan, being recorded from the southern region only. In the Imperial Museum are specimens of this species from Suruga Bay and from Kagoshima. No specimens taken by Jordan and Snyder.

(*brevis*, short; *rostrum*, snout.)

Family II. BALISTIDÆ.

TRIGGER FISHES.

Body oblong, or ovate, moderately compressed, covered with rather large rough scales or scutes of varying form, the scutes not forming an immovable carapace. Lateral line obscure or wanting. Mouth small, terminal, low; jaws short, each with about 1 series of separate incisor-like teeth; eye near occiput; preorbital very deep. Chin without barbel. Gill openings small, slit-like, above or in front of pectoral fins, and not before eyes. Dorsal fins 2, the anterior of 2 or 3 spines, the first spine highest, very strong, the second locking it in erection; second dorsal remote from the first, of many soft rays; caudal fin rounded or forked; ventral fins wanting, their place occupied by a single stout, thick spine at the end of the very long, usually movable pubic bone. Post-temporal short, simple, the forks obliterated, the bone grown solidly to the skull, and with no foramen. Vertebrae in reduced number (17). Shore fishes of the tropical seas, of rather large size, carnivorous, or partly herbivorous, very rarely used as food, many of them reputed to be poisonous.

a. Caudal peduncle compressed.

b. Teeth white or pale, not red.

c. Teeth unequal, oblique, each one deeply notched.

d. Gill opening with a number of enlarged bony plates or scutes behind it; ventral flap movable, supported by a series of spines, more or less free at tip, and resembling fin rays.

e. Dorsal and anal fins low and rounded, their angles and those of caudal not produced; lateral line obsolete or with a trace at the shoulder; scales of posterior parts each with a blunt spine or tubercle; ventral flap narrow, its supporting spines stout and thick in the adult; third dorsal spine small.

f. Eye with a naked groove before it.

g. Cheeks with small scales closely set; snout scaly.....*Pachynathus*, 3.

gg. Cheeks with large scales loosely set; snout naked...*Pseudobalistes*, 4.

ff. Eye without preocular groove.....*Balistapus*, 5.

dd. Gill opening with only ordinary scales behind it; no enlarged plates or scutes; ventral flap scarcely movable, its surface scaled; lateral line obsolete; third dorsal spine small or wanting; vertical fins in adult more or less angulate or falcate.

h. Chin not projecting; cheeks closely scaled; dorsal spine 3; scales of posterior parts unarmed or keeled*Canthidermis*, 6.

3. PACHYNATHUS Swainson.

Pachynathus SWAINSON, *Classn. Fishes*, II, 1839, p. 326 (*triangularis*=*capistratus*; the name evidently an error for *Pachygnathus*, but not so spelled; not *Pachygnathus*, an earlier name of a genus of spiders.)

This genus differs from *Balistes* in the rounded outlines of the vertical fins and in the possession of small spines or tubercles on the scales of the caudal region. Ventral flap somewhat movable, its sup-

porting spines short and very thick. Lateral line reduced to a trace at the shoulder. Species few, inhabiting the Pacific, intermediate between *Balistes* and *Balistapus*. The name *Pachynathus* is, perhaps, ineligible, as if spelled correctly it is preoccupied.

(παχύς, thick; γνάθος, jaw.)

- a. Color olivaceous, with a pale ring about the mouth and usually a pale line behind it; caudal double truncate; D. III, 29; A. 28; scales 50.....*capistratum*, 3.
 aa. Color dusky with a green area marked by dark spots above; lower parts with large round blotches of dull red; a blue ring about snout; caudal rounded. D. III, 25, A. 21; scales 46.....*conspicillum*, 4.

3. PACHYNATHUS CAPISTRATUM (Shaw).

Le Baliste bridé LACÉPÈDE, Hist. Nat. Poiss., I, 1798, p. 335; without locality; on a drawing by Commerson.

Balistes capistratus SHAW, Genl. Zool., V, 1804, p. 417 (after Lacépède; not *Pachynathus capistratus* Jordan and Evermann, which is a distinct species, with smaller scales, = *Pachygnathus verres* Gilbert and Starks.)

Balistes mitis BENNETT, Proc. Comm. Zool. Soc., I, 1831, p. 169; East Indies.—GÜNTHER, Cat., VIII, 1870, p. 218.

Balistes amboinensis GRAY, Hardwicke, Illus. Indian Zool., 1834; Amboyna.

Pachynathus triangularis SWAINSON, Classn. Fishes, II, 1839, p. 326 (Vizagapatam, after Russell, pl. xx.)

Balistes hihpe RICHARDSON, Voy. Sulphur, Fishes, 1843, p. 127; East Indies.

Balistes frenatus RICHARDSON, Voy. Sulphur, Fishes, 1843, p. 129; East Indies.—BLEEKER, Atlas Ichth., 1865-69, pl. cccxxiii.

Balistes schmittii BLEEKER, Verh. Bat. Gen., XXIV, 1852, p. 37; Sumatra.

Head $2\frac{2}{3}$; depth 2; D. III. 28 to 30; A. 25 to 27; scales 50. Body rather oblong, a groove before the eye. Each scale for about 9 rows on the tail and posterior part of sides, with a small, smooth, inconspicuous tubercle; about 34 scales in several parallel horizontal streaks in front of pectoral, a transverse series from soft dorsal to vent; a few bony scutes behind the gill opening, 1 of these considerably enlarged. Lateral line obsolete, reduced to a few scales behind eye. Dorsal and anal fins rather low, with outlines rounded or slightly angular in front, the first rays not produced; the caudal double truncate, the angles scarcely produced. First dorsal spine strong, very rough, especially above. Ventral flap small, movable, supported by several short, thick spines. Uniform blackish brown; a yellowish ring from middle of upper lip around the lower jaw, a straight yellow stripe from this ring toward the pectoral, not reaching the gill opening; this sometimes absent or indistinct. Pacific Ocean; widely distributed through the East Indies and on the coast of China. Here described from an adult example from Wakanoura.

This species is very abundant in the East Indies and westward to Honolulu. One specimen secured at Wakanoura, and another was obtained for us by Yonekichi Koneyama, who caught it at Nafa in Okinawa. There are no other records from Japan, but we have many examples from Hawaii.

The American species, heretofore called *Pachynathus capistratum*, is different from Japanese or Hawaiian specimens, having larger scales. It has been named *Balistes verres* by Gilbert and Starks. (*capistratus* bridled.)

4. PACHYNATHUS CONSPICILLUM (Bloch and Schneider).

MONGARA KAWAHAGI (SPOTTED SKIN PEELER), KOMONIUWO (BLOTCHED FISH).

Balistes conspicillum BLOCH and SCHNEIDER, Syst. Ichth. Bloch, 1801, p. 474; Indian Seas (after *Guaperva tacheté* of Sonnerat).—SCHLEGEL, Fauna Japonica, 1846, p. 289, pl. CXXIX, fig. 1; Nagasaki.—BLEEKER, Atlas Ichth. Balist., 1865-69, p. 116, pl. VII, fig. 2.—GÜNTHER, Cat. Fish., VIII, 1870, p. 220; Japan, Formosa.—NAMIYE, Cat. Spec. Vert., 1881, p. 113, Kishin.—ISHIKAWA, Prel. Cat., 1897, p. 4, Kagoshima.

Balistes bicolor SHAW, Gen. Zool., V, 1804, p. 407, pl. II.

D. III, 25 to 26; A. 21 to 22; scales in lateral line 46, or about 50 to 55 from gill opening to middle part of caudal. Eye 4 to 6 in head, $2\frac{1}{2}$ to 4 in snout. Head higher than long; lips broad and fleshy; patch of enlarged scales 3 or 4 in number behind the gill opening; about 29 scales in a transverse section from the origin of the dorsal to the vent; dorsal and anal rather low; caudal subtruncate; ventral spine very short and movable; two and a half series of tubercles on caudal peduncle; caudal rounded, the angles not produced; lateral line not conspicuous. Color brownish or black, with very large, round, yellow spots on the lower part of the body in 4 longitudinal series. Back between dorsals of a lighter coloration. The center of each scale brown and the edges yellowish; a yellowish band across the snout from one eye to the other; extremity of the snout orange and with a narrow orange ring; pectorals with yellow or orange rays; spinous dorsal brown or blackish; soft dorsal and anal grayish blue and with orange bases; caudal black at base, medianly clear yellow, with a marginal black band. Length 13 inches. (Schlegel, Bleeker. Günther; the color after Schlegel.)

This species is occasionally taken in the Kuro Shiwo, off the coast of Japan and southward. It is recorded from Nagasaki and Kagoshima, and we have examined a specimen from Urakawa, in Hokkaido, preserved in the museum at Hakodate. This has: D. III, 24; scales 44. A specimen from Kii is in the Imperial University.

(*conspicillum*, a pair of spectacles, in allusion to the round spots.)

4. PSEUDOBALISTES Bleeker.

Pseudobalistes BLEEKER, Atlas Ichth. Balist., III, 1865-69, p. 113 (*flavimarginatus*)

This genus differs from *Pachynathus* in the large size of the scales on the cheek, which do not cover the whole surface, though not leaving the naked stripes seen in *Parabalistes*. Snout naked. Caudal

lunate, but not deeply forked. Dorsal and anal low, as in *Balistapus*. Scales of the tail with tubercles. Pacific Ocean.

(*ψευδής*, false; *Balistes*, from *βαλιστήρ*, shooter, which is from *βάλλω*, to shoot with a crossbow; in allusion to the trigger-like third spine, which sets or releases the first spine, as in a crossbow.)

5. PSEUDOBALISTES FLAVIMARGINATUS (Rüppell).

SURUMICHI.

Balistes flavimarginatus RÜPPELL, Atlas Fische, 1828; p. 33; Red Sea.—BLEEKER, Atlas Ichth. Bal., 1865-69, p. 113, pl. IV, fig. 3; pl. X, fig. 3.—GÜNTHER, Cat. Fish., VIII, 1870, p. 223; Red Sea, Amboyna.—ISHIKAWA, Prel. Cat., 1897, p. 4; Riu-kiu Islands.

Balistes beeri BLEEKER, Act. Soc. Sci. Indo-Neerl., V. 1856, Celebes, p. 53; Celebes.

D. III. 26 to 27; A. 23 to 25; scales in lateral line 35 to 36. Eye 3 to 5 in head, $1\frac{1}{3}$ to 4 in snout. Lips broad and fleshy; snout partly naked; interorbital space strongly convex; 3 or 4 osseous scutes behind the gill opening; about 20 scales in a transverse series from the origin of the dorsal to the vent; soft dorsal and anal somewhat elevated; caudal rounded in very young, truncate in half-grown and deeply emarginate, with produced lobes in adult examples; ventral spine short, movable; on the caudal peduncle 4 to 6 series of rather small recurved spines. Color of adult, yellowish or violet green, without conspicuous spots, nearly uniform; fins except spinous dorsal blackish violet on the basal part, the outer extremities yellowish, crossed by a longitudinal blackish-violet bar; spinous dorsal reddish, margin black, in half-grown examples yellowish or brownish orange; numerous blackish or brownish spots on trunk; posterior fins olive-brown, margined with yellow; young, brownish above, below pale yellow; spotted on the sides; base of spinous dorsal blackish; the fins yellow. Length, 23 inches. (Bleeker, Günther.)

Of this species, common in the East Indies, we have one small specimen, $1\frac{1}{4}$ inches long, from Wakanoura. Head $2\frac{1}{2}$ in length; depth $1\frac{2}{3}$; eye large, $1\frac{2}{3}$ in snout; edges of snout without scales; cheeks less closely scaled than the rest of the head; pectorals short; ventral spine very rough; caudal rounded; upper surface of the head, basal dorsal spines and back blackish; several dark bars at base of caudal; sides of the body spotted with blackish.

(*flavus*, yellow; *marginatus*, edged.)

3. BALISTAPUS Tilesius.

Balistapus TILESII, Mém. Ac. Nat. Sci., Petersb., about 1812, VII, p. 301 (*capistratus* of Tilesius, not of Shaw, *undulatus*).

Rhinccanthus SWAINSON Classn. Anim., II, 1839, p. 325 (*oruatissimus*=*aculeatus*).

This genus has the head and body closely scaled, the scales of the posterior parts more or less spinous; enlarged scales behind the gill

opening, the lateral line obsolete and no groove before the eye. The species are numerous in the Indian seas. They are small and rather brightly colored.

(balistes, ἄπλους, footless.)

- a. Body covered from snout to tail with many oblique wavy reddish lines; D. III, 25, A. 24; scales 50; spines on tail in a black patch *undulatus*, 6.
 aa. Body greenish above, brownish or whitish below; 4 or 5 oblique stripes on sides posteriorly; 3 blue stripes vertically from eye; the colors anteriorly separated by a blue line; 3 blue stripes vertically from eye; a pale patch under caudal spines *aculeatus*, 7.

6. BALISTAPUS UNDULATUS (Park).

TOKUSA ZAME (SCOURING RUSH SHARK).

Balistes undulatus MUNGO PARK, Trans. Linn. Soc., III, 1797, p. 37.—GÜNTHER, Cat. Fish., VIII, 1870, p. 226; Red Sea, Zanzibar, Moluccas, Sumatra, Amboyna, Ceram, Cebu, Louisiades, China, Japan.

Balistes lineatus BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 466, pl. LXXXVII. Coromandel.—BLEEKER, Atlas Ichth., 1865-69, p. 118, pl. xv, fig. 2.

Balistes aculeatus viridis BENNETT, Fish, Ceylon, 1830, pl. x; Ceylon.

Balistes lamourouxi QUOY and GAIMARD, Voy. Uranie Zool., 1824, p. 208, pl. XLVII, fig. 1.

Balistes sesquilineatus BENNETT, Beechey's Voy., 1839, p. 69, pl. XXI, fig. 3; Tahiti.

Balistes porcatus GROSNOW, Syst., Ed. Gray, 1854, p. 32; Indian seas.

Head 3; depth $1\frac{3}{4}$; D. III., 25 to 27; A. 22 to 24; scales in lateral line 41, or about 50 from gill opening to under part of caudal; no groove before eye; eye $3\frac{1}{2}$ to $5\frac{1}{2}$ in head, 2 to 4 in snout. Head higher than long, slightly concave above; lips broad and fleshy; jaws equal; patch of 4 enlarged scales behind gill opening. A transverse series of 24 scales running from the origin of the dorsal fin to the vent; dorsal and anal fins rather low, with rounded profile; caudal fin subtruncate; pectoral obtusely rounded; ventral toothed; double series of lateral spines, 4 to 8 in number, on the caudal peduncle. Color bluish-violet, fin rays yellow or golden-rose; membranes hyaline-blue or violet; head and body with numerous oblique and somewhat undulated reddish or yellowish stripes, two broader than the others, proceed from the lips and are confluent posteriorly; spinous dorsal reddish with brownish yellow and black margins; the spines on each side of the tail in a black patch; base of caudal washed with blackish. (Bleeker, Günther.)

Of this species Günther records a stuffed specimen from Japan, probably from the Rinkiu Islands. Another from unknown locality is in the Imperial Museum at Tokio. It is common in the East Indies.

(*undulatus*, waved.)

7. *BALISTAPUS ACULEATUS* (Linnaeus).

Balistes aculeatus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 328; India.—BLEEKER, Atl. Ichth. Balist., 1865-69, p. 120, 1866, pl. II, fig. 3; East Indies, on all islands (and of all writers).—GÜNTHER, Cat. Fish., VIII, 1870, p. 223; Ile de France, Johanna, Zanzibar, Moluccas, Amboyna, China, Fiji, Seychelles, Mauritius.

Balistes ornatissimus LESSON, Voy. Coquille, I, 1824, p. 119, pl. x, fig. 1.

Balistes armatus CUVIER, Règne Anim. Illustr., pl. CXII, fig. 2.

Balistes striatus GRONOW, Syst., Ed. Gray, 1854, p. 32; American seas.

Head $2\frac{3}{4}$, depth $2\frac{1}{4}$, D. III. 25; A. 22; scales 44 in the lateral line. Body oblong, elliptical, no groove before the eye. On the sides of the caudal peduncle are 3 rows of strong spines, directed forward, consisting of 11, 9, and 5, respectively. Head long, angular, and deeper than long; the snout very long, nearly as long as the head, slightly convex; eye small and high up, $6\frac{1}{2}$ in head, $5\frac{2}{3}$ in snout, and $1\frac{2}{3}$ in interorbital space; interorbital space moderately convex; lips broad, thick, and fleshy; corners of mouth fleshy for some distance backward; snout not scaled; teeth large and strong, the middle the larger, then diminishing toward either end, wedge shape, the ends wider than the bases, the cutting edges notched, and in the upper jaw 8 in the outer and 6 in the inner series, the latter with their edges rounded; in the lower jaw 8 in a single series; the upper jaw closes outside the lower; gill opening equal to interorbital space, and with 4 enlarged bony scales behind; scales 29 in a transverse series from spinous dorsal to anal; pectoral one-fourth longer than gill opening; first dorsal spine very robust, larger than pectoral; dorsal and anal highest anteriorly, rounded; caudal subtruncate; ventral movable, very rough and with several strong spines behind; ridge of belly before ventral also very rough; caudal peduncle deeper than broad and a little less than the interorbital space; body not very rough; the scales largest on the trunk.

Color in spirits pale brownish above, lighter below; spinous dorsal, large patch on sides behind gill opening sending a line to space between the dorsals and another broader track to posterior half of soft dorsal, dark brown; broad band across interorbital space grayish brown with 3 dark-brown bars across from one eye to the other, the narrower interspaces bluish, a brown band from eye to base of pectoral edged narrowly with grayish and a narrow gray or bluish line from eye running convexly to lower base of pectoral, a brownish bar from naked region at corner of mouth nearly to pectoral, with a wash of grayish white below; sides of belly from behind and below enlarged scales behind gill opening to vent, together with 4 posterior oblique bars running in the same direction and patch on caudal peduncle in which spines are placed, white; some black about the bases of the caudal spines; vent and narrow stripe at base of pectoral in front blackish brown; fins

all plain. Total length $9\frac{1}{2}$ inches. Here described from a specimen from Okinawa.

This species is very common throughout the East Indies and the equatorial islands of Polynesia as far as Hawaii. It is represented in our collection by one large example from Nafa, in Okinawa, collected by Y. Koneyama. There is no other record from Japan.

(*aculeatus*, bearing spines or needles.)

6. CANTHIDERMIS Swainson.

Canthidermis SWAINSON, CLASS. ANIM., 1839, II, p. 325 (*angulosus*=*maculatus*).

This genus differs from *Balistes* chiefly in having the gill opening surrounded by ordinary scales, there being no developed bony scutes behind it. Body much more elongate than in *Balistes*; dorsal spines 3; dorsal and anal elevated in front; caudal with its angles acute; scales moderate, not very rough; scales of caudal peduncle unarmed, or with a medium spine; cheeks completely scaled; a naked groove before eye. Species inhabiting both Indies.

(*ἄκανθα*, spine; *δέρμα*, skin, the word, as usual, misspelled by Swainson.)

8. CANTHIDERMIS ROTUNDATUS (Procé).

Balistes rotundatus PROCÉ, Bull. Soc. Philom., 1822, p. 130; Manila ("D. III. 26, A. 21. Scales equal; tail unarmed, brown with black spots.")

Balistes azureus LESSON, Voy. Coquille, II, 1824, p. 121, pl. x, fig. 2.

? *Balistes angulosus* QUOY and GAIMARD, Voy. Uranie, Zool., 1824, p. 210.

Balistes oculatus GRAY, Hardwicke's Illustr. Ind. Zool. Fish., 1832, pl. VIII, fig. 1; India.—BLEEKER, Atlas Ichth. Balist., 1865-69, p. 121, pl. IV, fig. 2.

?? *Balistes adpersus* TSCHUDI, Fauna Peruana, 1846, p. 31; Peru.

Balistes senticosus RICHARDSON, Voy. Samarang, Fish., 1850, p. 23, pl. IX, figs. 5-8; China Sea.

Balistes maculatus GÜNTHER, Cat. Fish., 1870, VIII, p. 214; Cape of Good Hope, Pinang, Borneo, Sandalwood Island, China, Japan (in part, not of Bloch, whose type came from the West Indies).—DAY, Fish, India, p. 687, 1878, pl. CLXXXVI, fig. 3; Madras.

B. IV. D. III., 26 or 27; P. 15; A. 24 or 25; C. 12; scales 46 to 55; L. tr. 28; length of head $3\frac{2}{3}$ to 4; of caudal fin $6\frac{1}{2}$ to 7, height of body $2\frac{1}{2}$ to 3 in total length; eye 2 to $2\frac{1}{2}$ diameters from end of snout and 2 apart. A groove in front of eye. Teeth uneven, notched. First dorsal fin commences above gill opening, its anterior spine strong and nearly $\frac{1}{2}$ as long as head; ventral spine usually movable; posterior edge of caudal convex or undulated; second dorsal and anal high anteriorly, especially in adults. Cheeks entirely scaled; no osseous scutes behind gill opening. Scales rough and granulated, but without spines or prominent tubercles, except in the immature. Bluish black young examples are covered with numerous light blotches, more especially on lower half of body, these spots are less numerous and larger in adults; dorsal spines black; eyes hazel. Indian and Pacific oceans. It is very common at Madras, attaining at least 16 inches in length.

This species is common in the East Indies, and one (Day) young example has been recorded by Dr. Günther from Japan, probably from the Riukiū Islands. The proper specific name is uncertain, as the oldest specific name in this group, *Canthidermis maculatus*, belongs to an American species. The earliest name applicable seems to be *rotundatus* applied by Manon de Procé to a specimen from Manila. The species must be rare or casual in Japan. No examples were taken.

(*rotundatus*, rounded.)

Family III. MONACANTHIDÆ.

FILE FISHES.

Body much compressed, covered with very small rough scales, forming a rough or velvety covering; males sometimes with spines on the caudal peduncle; these either robust or needle-like. Upper jaw with a double series of incisor-like teeth, 6 in the outer and 4 in the inner series; lower jaw with 6 similar teeth in a single series; first dorsal with a single strong spine and generally a rudimentary one behind it; second dorsal long, similar to anal; ventral fins reduced to a single osseous, fixed or movable, small appendage at the end of the long pelvic bone; this appendage often rudimentary or entirely absent; no barbel; vertebrae 7 + 11 to 14 = 18 to 21. Herbivorous shore fishes of the warm seas, closely allied to the *Balistidæ*, differing chiefly in having the first dorsal represented by a single spine, behind which is sometimes a rudiment; scales small, spinigerous, the skin mostly rough velvety. The species are mostly small in size and are not used for food, having little flesh and that of a bitterish taste, containing poisonous alkaloids producing the disease known as *Ciguatera*.

- a. Pubic bone with a small spine at its end; gill opening short, nearly vertical; dorsal and anal moderate, each of less than 40 rays.
- b. Pelvic spine movable, dorsal spine with two series of retrorse barbs, the posterior pointing downward and backward.
- c. Abdominal flap developed into a broad fan supported by branched rays and extending far beyond the pelvic spine.....*Monacanthus*, 7.
- cc. Abdominal flap little developed, extending little beyond the pelvic spine, and with inconspicuous rays.....*Stephanolepis*, 8.
- bb. Pelvic spine fixed; dorsal spine with strong barbs behind, with usually smaller barbs in front.
- d. Body oblong and elliptical; depth of body less than half length to base of caudal; dorsal and anal usually with more than 30 rays each.
Pseudomonacanthus, 9.
- dd. Body short and deep; depth of body more than half length to base of caudal; dorsal and anal relatively short.....*Rudarius*, 10.
- aa. Pelvic bone without spine at its end.
- e. Dorsal and anal short, each of less than 30 rays, body rather plump.
- f. Body subcircular; dorsal spine rough, without barbs, inserted over the eye.....*Brachaluteres*, 11.
- ff. Body oblong; dorsal spine smooth, enveloped in skin, adnate to the back, and inserted behind eye.....*Paraluteres*, 12.

- ee. Dorsal and anal very long, each of 36 to 50 rays; body lean and strongly compressed; dorsal spine without barbs; gill opening long, oblique.
- g. Dorsal spine feeble, inserted over the eye; dorsal rays about 45.
- h. Caudal fin short, subtruncate, anterior profile convex . . . *Alutera*, 13.
- hh. Caudal fin elongate, rounded, or lanceolate; anterior profile concave, the snout very long *Osbeckia*, 14.
- gg. Dorsal spine straight, inserted well in advance of eye; dorsal rays about 43 *Pseudaluteres*, 15.

7. MONACANTHUS Cuvier.

Monacanthus CUVIER, Règne Animal, 1st ed., 1817, p. 152 (*chinensis*.)

Body short and deep, very strongly compressed, covered with minute, rough scales, the anterior profile more or less concave. Mouth very small; upper jaw with a double series of incisor-like teeth, usually 6 in the outer and 4 in the inner series; lower jaw with about 6 incisors in a single series; teeth connivent, unequal; gill opening a small slit, shorter than the eye, and just in front of upper edge of pectoral. Dorsal spine large, armed with 2 series of retrorse barbs, and no conspicuous filaments; second dorsal and anal fins similar to each other, of about 25 to 35 rays each; caudal fin moderate, rounded; pelvic bone with a blunt, movable spine, the bone connected to the abdomen by a movable flap, or dewlap, of very great size, extending far beyond the body, like a fin, and supported by branched flexible rays, resembling fin rays; side of tail often with a patch of spines, especially in the males. Vertebrae 7 + 11 to 14 = 18 to 21. Species few, in warm seas, reaching a moderate size. All are lean fishes, with leathery skin, and bitter flesh unsuitable for food.

(μόνος, one; ακανθα, spine.)

9. MONACANTHUS CHINENSIS (Osbeck).

Balistes chinensis OSBECK, *Iter Chinensis*, 1757, p. 147; China.—BLOCH, *Ichthyol.*, II, 1787, p. 29, in later editions pl. LI, fig. 1; China.

Monacanthus chinensis, CUVIER, *Règne Animal*, 1st ed., p. 152, 1817 (name only).—BLEEKER, *Atlas Ichth.*, V, 1865-69, p. 125, pl. CCXXII, fig. 2.—GÜNTHER, *Cat. Fish.*, VIII, 1870, p. 236; China, Pinang, Singapore, Shanghai.

Balistes sinensis GMELIN, *Syst. Ichth.*, I, 1788, p. 1470 (after Bloch).

Monacanthus geographicus ("Péron"), CUVIER, *Règne Animal*, 2d ed., 1829, p. 373; Pinang.—CANTOR, *Malayan Fishes*, 1850, p. 347; Pinang, Singapore.

Monacanthus cantoris BLEEKER, *Nat. Tyds. Ned. Ind.*, III, 1852, p. 80 (after Cantor).

Balistes granulatus GRONOW, *Syst.*, Ed. Gray, 1854, p. 34; Indian Seas.

Head $3\frac{3}{4}$; depth 2 at origin of dorsal. D. I. 32; A. 31. Body compressed, deep, and covered with small scales; very rough. Head deep, the upper profile concave; snout produced upward, $1\frac{1}{2}$ in head; eye high, small, $4\frac{1}{2}$ in head, $3\frac{1}{2}$ in snout, $1\frac{1}{4}$ in interorbital space, equal to space between its lower margin and upper edge of gill opening, and $1\frac{1}{2}$ in the gill opening; mouth small, high, and level with the upper part of the gill opening; lips smooth, thick, and fleshy; teeth strong

and very slightly emarginate; jaws subequal; interorbital space very high and rounded; gill opening below eye oblique, its lower end in advance of the base of the pectoral and with a narrow fleshy flap. Spinous dorsal over the eye and posterior, rough, moderately thick, and with a series of large antrorse spines on each side; its origin nearer the tip of the snout than the origin of the soft dorsal; back with a triangular elevation, the apex the origin of the soft dorsal, and the origin of the anal falls a little behind this and below; dorsal and anal with their middle rays elevated; caudal deep, the middle rays long and the edge rounded; pectoral short and bluntly rounded, and equal to space between the lower margin of the eye and the lower edge of gill opening; ventral spine rough, a small spine on each side at base, movable, and a little longer than the eyes; abdomen behind ventral spine, between it and anus, developed into a long flap extending out from the body, beyond the ventral spine as far as the anal rays do themselves, and supported by very numerous, long, slender, cartilaginous stays resembling fin rays. Lower ventral region very roughly striated toward the ventral fin on each side; caudal peduncle very rough, the tubercles enlarged and less numerous posteriorly, where there are two series of large spines curved outward and forward with 3 in each series.

Color of the body brown; 4 dark bars across the dorsal spine; soft dorsal with several narrow, wavy, longitudinal, blackish bars, the marginal portion with many small round light spots; anal with series of narrow, wavy, longitudinal, blackish bars, forming a network on the outer portion of the fin; caudal with many narrow blackish vertical bars over 3 dark bars, the outermost the darkest; pectoral plain; sides at the ventral region and at the base of the ventral fin blackish, the flap itself marked with narrow, wavy, blackish, netted bars. Total length $10\frac{5}{16}$ inches. Our description is from a specimen obtained for us at Hongkong by Capt. William Finch, of the steamer *Gaelic*.

This species, very common on the coast of China from north China to Singapore, occurs in the Riukiu Islands and perhaps also in Japan. It is well figured in Bleeker's Atlas.

8. STEPHANOLEPIS Gill.

Stephanolepis GILL, Proc. Ac. Nat. Sci. Phila., 1861, p. 78 (*setifer*).

This genus, which includes the larger number of species of *Monacanthidae*, differs from *Monacanthus* in the little extension of the ventral flap, which does not form a dewlap and extends little beyond the ventral spine even in the adult. The surface of the flap is rough, with modified scales, but internal rays do not appear without dissection. Caudal peduncle usually without spines. The species are found in the warmer waters of both Asia and America.

(στέφανος, crown; λεπίς, scale.)

- a. Body comparatively deep, the depth in the adult about $1\frac{3}{4}$ in the length.
- b. Dorsal and anal rays about 34; dorsal fin in adult with the second soft ray much produced; none of the caudal rays produced; sides with several rather faint horizontal interrupted dark bars.....*cirrifer*, 10.
- bb. Dorsal rays 27 or 28; depth $1\frac{3}{8}$ in length; scales very rough; no cirri on the fins; color, clouded brown.....*japonicus*, 11.
- aa. Body elongate, the depth about $2\frac{1}{4}$ in the length; soft dorsal and anal high, of about 26 rays; one or more of the caudal rays produced in long filaments; color, mottled brown.....*oblongus*, 12.

10. STEPHANOLEPIS CIRRHIFER (Schlegel).

KAWAHAGI (SKIN SCRAPER), MAHAGI (TRUE SCRAPER), KAWAMUKI (SKIN PEELER); TOKOSE; CHUKO; TSANOKE.

?? *Monacanthus setifer* BENNETT, Proc. Comm. Zool. Soc., 1830, p. 112.

Monacanthus setifer GÜNTHER, Cat. Fish., VIII, 1870, p. 239; in part Japan, China, Zanzibar.—NYSTROM, Sven. Vet. Handl., 1887, p. 47; Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 3; Boshu, Misaki; not of Bennett.

Monacanthus cirrhifer SCHLEGEL, Fauna Japonica, 1846, p. 290, pl. cxxx, fig. 1; Nagasaki.—BLEEKER, Act. Soc. Sci. Indo-Nederl., III, 1857, Japan, IV, p. 31.—STEINDACHNER, Reise Aurora, 1898, p. 223; Kobe.—JORDAN and SNYDER, Check List. 1901, p. 93; Yokohama.

Monacanthus komuki BLEEKER, Verh. Ak. Wet., I, 1853, p. 13, fig. 1; Kaminoseki, D. I. 32; A. 31.—BLEEKER, Act. Soc. Sci. Indo-Nederl., III, 1857, Japan, IV, p. 31; Kaminoseki.

Head $3\frac{2}{5}$; depth $1\frac{3}{8}$ to $1\frac{1}{2}$; D. I. 34; A. 33. Body deep, strongly compressed. Head much deeper than long; snout produced, and the upper profile line concave; lips thick and fleshy; edges of snout smooth; teeth powerful, the edges emarginate; upper jaw projecting when the mouth is closed; eye high up. 4 in head, 1 in space between its lower margin and gill opening, 3 in snout and 4 in interorbital space; gill opening as long as its distance from eye above, and with a fleshy flap; spinous dorsal directly behind eye, and much nearer soft dorsal than tip of snout; spine roughened on front, not thick, and with a series of antrorse barbs along the sides; its length varying from one-half to two-thirds the space between its base and first soft dorsal ray. Soft dorsal higher than anal and caudal peduncle, and with its anterior rays the highest; caudal rays strong, the edge of fin convex but exceeding the caudal peduncle. Ventral spine small, roughened, and movable. Body smooth, but roughened between the ventral spine and the anus.

Color in spirits brownish; dorsal spine with four dark-brown bars; bases of soft dorsal and anal dark brown; the edges of the fins paler; caudal pale brown, with a terminal and median dark-brown bars; on sides many indistinct longitudinal bars of dark brown and on head and belly numerous small, indistinct brownish spots. Here described from specimens from Nagasaki, the largest reaching $10\frac{1}{4}$ inches.

In young examples the markings on the sides are more distinct; and a dark spot is mostly evident on the upper side of the back; the gill opening shorter than the eye; dorsal spine robust. In only 3

specimens is the second dorsal prolonged into a filament, 2 of them being from Misaki, the other from Hakata.

This fish is very common in shallow sandy bays in southern Japan. In color and form it approaches very closely to the Atlantic species, *Stephanolepis hispidus*, which Dr. Günther considers a "variety" of the same species. Steindachner claims that the Japanese species, *Monacanthus cirrhifer*, is distinct from the East Indian, *Monacanthus setifer* Bennett. The upper line of the head (in *M. cirrhifer*) is steeper, and the snout less projecting, and the dorsal spine shorter than in *M. setifer*. Our many specimens are from Tokyo, Misaki, Totomi Bay, Onomichi, Wakanoura, Kobe, Tsuruga, Hakata, and Nagasaki.

The species has many names in Japan, the commonest, Kawahagi and Kawamuki (wrongly spelled Komuki by Bleeker), meaning a fish which must have its skin peeled or scraped off before eating. Most of these names are also loosely applied to other *Monacanthidae*, *Balistidae*, and *Acanthuridae*. The present one is called Mahagi, the true skin-scaper.

(*cirrhifer*, bearing fringes of hair.)

II. STEPHANOLEPIS JAPONICUS (Tilesius).

YOSOGI.

*Monacanthus japonicus*¹ TILESIIUS, Mém. Soc. Moscou, II, 1801, pl. XIII; Japan (D. I. 24, A. 24).

Monacanthus trachyderma BLEEKER, Act. Soc. Sci. Indo-Neerl., VIII, 1860; Japan, VI, p. 70; Nagasaki.—GÜNTHER, Cat. Fish., VIII, 1870, p. 229.

Head, $2\frac{1}{8}$ to $2\frac{3}{8}$; depth, $1\frac{5}{8}$; D. I. 27 and 28; A. 28. Body oblong, deep, compressed, covered with rather large asperities, so that it is very rough to the touch. Head deeper than long, the upper profile nearly straight or very little concave; snout slightly produced; teeth strong, emarginate; lips rather thin, fleshy, and smooth; eye high in head, $2\frac{2}{3}$ in snout and $3\frac{1}{3}$ in head; interorbital space strongly convex. Gill opening below the posterior part of eye, a little longer than the space between the lower margin of the eye and its own upper extremity, with a narrow fleshy flap; spinous dorsal over posterior part of eye and midway between tip of snout and origin of soft dorsal; dorsal spine rather rough, and small antrorse spines in a single series laterally and posteriorly; origin of soft dorsal over that of anal, both of about

¹We are indebted to Mr. Garman for the following copy of Tilesius's account of *Balistes japonicus*:

"*Balistes jap.*, totus scaber, radio dorsali hispido postice aculeis recurvatis serrato, pinnis ventralis in unican coalitis, hispidis coriaceis monacanthis, oculis maximis argenteo viridiscensibus, membrana nectitante tectis, apertura branchiali simplici, maxilla superiore prominente pinna caudali ad latera inermi."

P. 10, V. $\frac{1}{2}$, A. 24, C. 20, D. $\frac{3}{4}$. The figure shows a small ventral flap. Ventral spine apparently immovable. Sides with cloudings and streaks. Body deep, two-fifths or more of total length.

equal height, with their anterior rays the longest and the margins of the fins obtusely rounded; caudal convex, the edges blunt; pectoral equal to the rather thick caudal peduncle; ventral spine produced and movable.

Color in alcohol dull brown with darker mottlings; spinous dorsal crossed by three dark brownish bands, another before its base, and still another from eye to eye; on the trunk are dark blotches, one at the origin of dorsal, two along the base of the anal; with the exception mentioned, all the fins are plain except the caudal, which has three

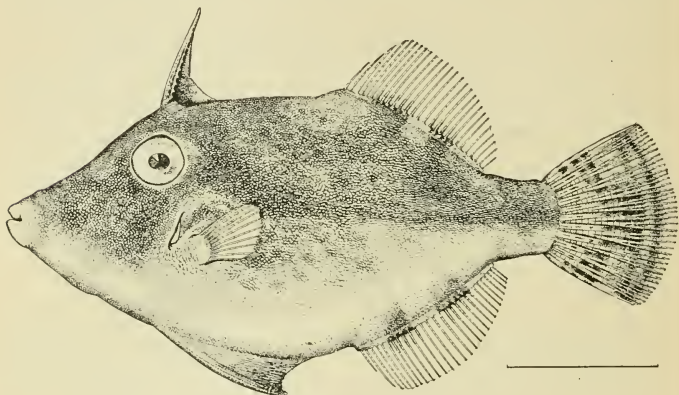


FIG. 1.—STEPHANOLEPIS JAPONICUS.

indistinct, broad dark bars, a brown ring around the snout, a bar across the throat below, and still another much farther below. The two specimens from which this description is taken were secured at Nagasaki, and measure $3\frac{1}{8}$ and $4\frac{3}{8}$ inches.

This species is known to us from two fine specimens taken at Nagasaki. It is well separated from *Stephanolepis cirrhifer* by the smaller number of fin rays, and by the rougher scales. It is probably not common.

12. STEPHANOLEPIS OBLONGUS (Schlegel).

UMAZURAHAGI (HORSE-FACE SCRAPER).

Monacanthus oblongus SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 291, pl. cxxx, fig. 2; Nagasaki (in part, figure and description of the young; two caudal filaments figured).—? BLEEKER, Act. Soc. Sci. Indo-Nederl., III, 1857, Japan, IV, p. 34, pl. III, fig. 1; Nagasaki (caudal figured with 4 upper, 4 median, and 2 lower filaments, 10 in all).—GÜNTHER, Cat. Fish., IV, 1862, p. 241; Japan, Zanzibar (?).

Monacanthus brocki BLEEKER, Act. Soc. Sci. Indo-Nederl., III, 1857, Japan, IV, p. 35, fig. 2; Nagasaki (caudal figured with 1 upper and 1 median filament; eye $2\frac{1}{2}$ in the long snout; dorsal spine short).

? *Monacanthus frenatus* PETERS, Monatsb. Ak. Wiss., Berlin, 1855, p. 464.

Head 3; depth $2\frac{1}{4}$; D. 1. 26; A. 27. Body oblong, compressed, and deepest anteriorly; skin fine velvety to the touch. Head deeper than long with the upper profile straight; snout not produced, blunt; eye high, 3 in snout, 1 in interorbital space, and 4 in head; interorbital space strongly convex; gill opening below the posterior part of the eye, level with the mouth, and greater than the space between its upper extremity and lower margin of eye; dorsal spine over the posterior part of the eye, finely striated, the sides with small antrorse spines behind, and its origin nearer the origin of the soft dorsal than the tip of the snout; soft dorsal and anal with their anterior rays very high, then rapidly diminishing in length till the last, which are very short, the lobe thus produced very blunt; caudal strong, its median rays the longest and forming a point, three of them ending in filaments, so that

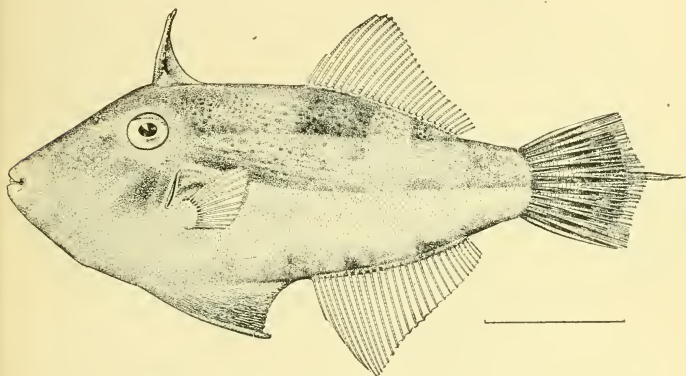


FIG. 2.—STEPHANOLEPIS OBLONGUS.

the upper and lower rays are the shortest; pectoral short, about equal to the deep, compressed caudal peduncle; ventral spine movable.

Color in alcohol brown marked with darker; a light streak from eye over gill opening on to the sides; several dark bars across dorsal spine, 1 at its base in front, and 1 from one eye to the other; traces of several dark bands across the throat; ventral region dark; 2 black spots on the back at the base of the dorsal, and 2 similar spots on the abdomen at the base of the anal; caudal brownish, with 3 indistinct cross-bars; membrane of spinous dorsal blackish; pectoral, ventral, and anal fins mostly plain; traces of several brownish bars across the throat. Here described from an example (with three caudal filaments) $4\frac{1}{2}$ inches long, from Nagasaki.

This species is easily distinguished by its oblong form, filamentous caudal and high soft dorsal in connection with the movable ventral spine. It has been rarely taken about Nagasaki. We have a single

specimen from that locality. This species is correctly described and roughly figured by Schlegel, who refers to it as the young of *Monacanthus oblongus*, regarding *Pseudomonacanthus modestus* as the adult of the same species. Schlegel's count of 5 rays (D-38; A-33) is evidently drawn from *Pseudomonacanthus modestus*. In the plates a much smaller number is shown. Our specimen corresponds to Schlegel's figure of *Monacanthus oblongus*, and to the account of *Monacanthus brocki* given by Bleeker. Bleeker's *oblongus*, with 10 caudal filaments, higher dorsal spine, and shorter snout may be a different species, but it is probable that the difference is one of age or sex. No two of the recorded specimens agree as to the number of caudal filaments.

(*oblongus*, oblong.)

9. PSEUDOMONACANTHUS Bleeker.

Pseudomonacanthus BLEEKER, Nedrl. Tydskr. Dierk., III. 1866, p. 11 (*macurus*).
Acanthaluteres BLEEKER, Atlas Ichth. Balist., 1865-69, p. 100 (*parugaudatus*).

This genus differs from *Monacanthus* chiefly in having the ventral spine immovably attached to the pelvic bone. The body is oblong, covered with velvety scales, the depth being not more than half the length. The dorsal spine has a row of retrorse barbs on each lateral edge, and usually a pair of rows of smaller barbs in front, the latter almost obsolete in old specimens. The species vary considerably in form. Chiefly East Indian.

(*φενδις*, false; *Monacanthus*).

13. PSEUDOMONACANTHUS MODESTUS (Günther).

CHACHE; KUROHAGI (BLACK SCRAPER).

Monacanthus oblongus SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 291; Nagasaki (in part, description of adults, not figures).

Monacanthus modestus GÜNTHER, Ann. Mag. Nat. Hist., 1877, p. 446; Inland Sea of Japan (D. II, 36; A., 34; depth, $2\frac{3}{4}$ in length; dorsal spine broken, see Boulenger).

Pseudomonacanthus modestus JORDAN and SNYDER, Check List, 1901, p. 93; Yokohama, Hakodate.

Monacanthus poljakovi HERZENSTEIN, Ann. Mus. Zool. Ac. St. Petersburg, 1896, p. 98; Yokohama, Coll. I. S. Poljakow. (Length 287 mm., depth $2\frac{3}{4}$ in length; D. II, 37; A., 35; adult specimen; profile convex.)

Monacanthus maximowiczii HERZENSTEIN, Annuaire Mus. Zool. Ac. St. Petersburg, 1896, p. 9; Hakodate, Coll. Maximowicz. (Length 144 mm., depth $2\frac{1}{4}$ in length; D. II, 37; A., 35; young example; profile concave).

Monacanthus ? ayraudi ISHIKAWA, Prel. Cat., 1897, p. 3; Boshu (not of Quoy and Gaimard).

Head $3\frac{2}{5}$ to $3\frac{3}{5}$; depth $2\frac{1}{5}$ to $2\frac{3}{4}$; D. I. 36 to 38; A. 34 to 36. Body elongate, strongly compressed. Head deeper than long; snout not produced much; upper profile mostly convex; lips not very thick and fleshy; median teeth of the mandible the largest and most powerful, and all with notched edges; jaws almost equal; eye high in head, $\frac{1}{4}$ in

snout, and 5 in head, greater than the space between its lower margin and the gill opening and a little less than $1\frac{1}{2}$ in interorbital space; nostrils small, gill opening $\frac{3}{4}$ the pectoral or equal to the convex interorbital space; with fleshy flap; spinous dorsal over posterior part of eye; its origin from midway to a point a little nearer the tip of the snout than the origin of the soft dorsal; rather slender spine, little roughed on front, and with 2 median series of very small tubercles, and a single series of antrorse barbs on each side. Soft dorsal and anal with the anterior rays much the longest, those of the former often more than half of the head; caudal rays strong, the edge convex; ventral spine small and rough; body smooth.

Color in spirits, pale brown, nearly uniform; the fins, deep vitriol blue, especially in the adult, outer portion of dorsal and anal darker than the base of the fin; caudal dark with the outer rays light. Here

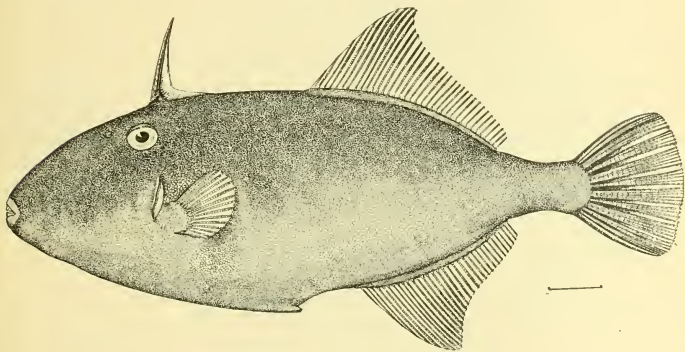


FIG. 3.—*PSEUDOMACANTHUS MODESTUS*.

described from specimens from Kobe, the largest $11\frac{1}{2}$ inches long. In young specimens the color in spirits is pale brown, darker above, the sides with 5 dark brownish series of spots or blotches, and the caudal blackish on the outer portion with the outer rays light.

This species is very abundant on the coasts of Japan, reaching the length of a foot, and often coming into the markets when its flesh is regarded as wholesome. It is, in fact, the commonest and most widely diffused of all the Japanese filefishes, extending its range to the far north. In life the vitriol blue color of the fish serves to distinguish it. The dorsal spine is smoother and much more flattened in the adult than in the young, and there is considerable variation in depth of body with age or sex. Our many specimens are from Otaru, Hakodate, Aomori, Tokio, Misaki, Tsuruga, Kobe, Onomichi, Hiroshima, Hakata, and Nagasaki.

(*modestus*, modest.)

10. RUDARIUS Jordan and Fowler.

Rudarius JORDAN and FOWLER, new genus (*ercodes*).

This genus has the immovable ventral spine of *Pseudomonacanthus*, with a short deep body, approaching that of *Brachaluteres*. (*rudis*, rough).

14. RUDARIUS ERCODES Jordan and Fowler, new species.

Pseudomonacanthus trachyderma JORDAN and SNYDER, (check list, 1901, p. 93; Yokohama (not of Bleeker).

Head 3 to $3\frac{2}{3}$; depth $1\frac{1}{4}$ to $1\frac{1}{2}$; D. I. 25 or 26; A. 24 or 25. Body short, deep and compressed; rather rough; the caudle peduncle some-

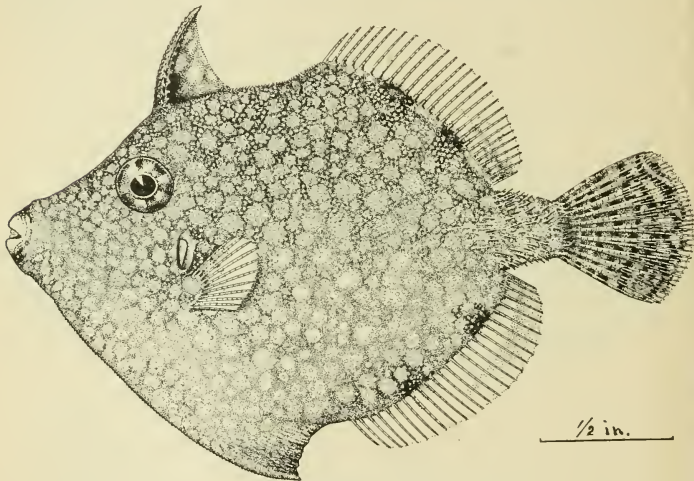


FIG. 4.—RUDARIUS ERCODES.

times with many slender curved spines. Head deep, its length about two-thirds its depth; eye rather large, superior, $1\frac{2}{3}$ in snout, $2\frac{2}{3}$ in head, equal to space between its lower margin and lower margin of gill opening; equal to caudal peduncle; interorbital space convex, greater than eye; upper profile concave; teeth emarginate, those in the lower jaw the larger; gill opening small, with narrow fleshy flap; lips moderately thick; jaws equal; spinous dorsal over posterior part of eye, convex, roughened in front; a single series of antrorse spines on each side, and its base midway or a little nearer the tip of the snout than the origin of the soft dorsal; soft dorsal and anal of nearly equal height; the origin of the latter a little in advance or under the origin of the former; caudal rounded; ventral spine short and rigid; pectoral equal or longer than the least depth of the caudal peduncle.

Color in alcohol brownish; the lower part of the head and abdomen lighter; the membrane of spinous dorsal pale like those of the soft dorsal and anal, but marked with one or more blackish blotches; pectoral pale; caudal pale, base frequently darker and marked with about 6 narrow wavy blackish bars; often several ill-defined blackish patches on the sides of the body, 2 at the base of the soft dorsal, 2 above the base of the anal, and 1 above the anal spine; brown lines, darker than the ground-color, forming round light spots everywhere on the trunk, though varying in some examples; chin with black band from each corner of the mouth, extended downward in the middle; a dark stripe from chin to eye, then another a little below this, and finally still another further below; here described from specimen from Misaki; length $2\frac{1}{2}$ inches. Little variation, except in depth of color, is to be found in our large series. Type No. 7127. Leland Stanford Junior University Museum.

This little fish, very different in appearance from *Pseudomomacanthus modestus*, may be recognized at once by its immovable ventral spine and its reticulated coloration. It is very common in the shallow bays of southern Japan. Our many specimens are from Tokio, Yokohama, Misaki, Tsuruga, Wakanoura, Onomichi, and Nagasaki.

(ἔρκος, a net; εἶδωσ, resemblance.)

11. BRACHALUTERES Bleeker.

Brachaluteres BLEEKER, Ned. Tyds. Dierk., III, 1866, p. 13 (*trossulus*).

Body very deep, almost circular, little compressed, covered with soft, velvety skin; no ventral spine; dorsal spine inserted above the eye; its surface rough with granules or bristles, but without barbs; fins short and low. Small fishes of the Australian and Japanese seas.

(βραχύς, short; *Aluteres*.)

15. BRACHALUTERES ULVARUM Jordan and Snyder, new species.

Head $3\frac{1}{5}$ to $3\frac{2}{5}$; depth $1\frac{2}{5}$ to $1\frac{1}{2}$; D. I. 27; A. 25. Body very deep, compressed, and fine velvety. Greatest depth of head twice its length; upper profile of the head slightly concave, the snout protruding a little; eye rather high in head, 2 in snout, $2\frac{1}{2}$ in head and distant from the lower edge of gill opening about twice its own diameter; inter-orbital space convex; mouth small, high in head; lips not very thick; teeth emarginate and pointed; the jaws subequal; pelvic profile very round and convex; gill opening small, half the diameter of the eye, nearly vertical, below the posterior part of the eye and entirely above the pectoral, and with narrow fleshy flap; base of spinous dorsal nearer the origin of the soft dorsal than the tip of the snout; spine short, moderately thick, and finely roughened in front; soft dorsal and anal low, and the origin of the latter a little behind or under that of the former; caudal equal to the head or a little shorter, and its margin

convex; pectoral short, rounded, and $1\frac{1}{2}$ in snout; caudal peduncle rather thick and deep, $1\frac{4}{5}$ to $2\frac{1}{3}$ in head; its sides in the larger examples covered with numerous fine slightly recurved bristle-like spines.

Color plain brownish, 2 narrow dark bars across forehead from one eye to the other; fins all plain except the dark blotch on the membrane of the spinous dorsal above, and the caudal, which is washed with darker at the base, and with about 12 blackish wavy bars, broad basally; on the sides of the body are a number of fine narrow dark bars running longitudinally; indistinct traces of 2 dark blotches along base of soft dorsal and base of anal on the body; a narrow dark stripe

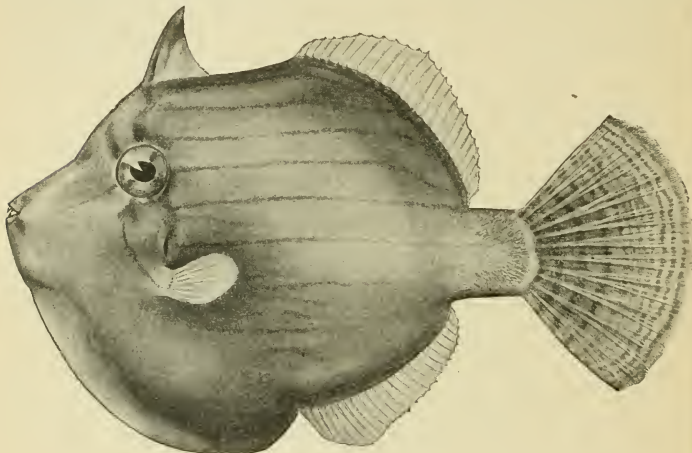


FIG. 5.—BRACHALUTEROS ULVARUM.

from eye down the sides of the snout, and another from the eye below convexly to the base of the pectoral. Here described from 2 examples from Misaki, $2\frac{3}{8}$ and $2\frac{7}{8}$ inches long. These are No. 7128. Leland Stanford Junior University Museum.

The species has been seen only in the bays around Misaki on the bottom of green sea weeds, where numerous specimens were taken.

(*ulva*, sea lettuce).

12. PARALUTERES Bleeker.

Paraluteres BLEEKER, Atlas Ichth., V. 1865-69, p. 138 (*prionurus*).

Body considerably longer than deep, not greatly compressed, covered with finely granular skin; sides of tail with fine bristles and two pairs of spines pointing forward; no ventral spine; dorsal spine moderate, curved, covered with smooth skin, inserted behind the eye and bound down by the integument so as not to be fully erectile.

One species, small in size and handsomely colored.

(*παρά*, near; *Aluteres*).

16. PARALUTERES PRIONURUS Bleeker.

Alutarius prionurus BLEEKER, Verh. Bat. Gen., Balist., XXIV, 1852, p. 20, pl. III, fig. 6; East Indies.—HOLLARD, Ann. Sci. Nat., II, 1854, pl. XIV, fig. 10, and 1855, p. 21.

Paraluteres prionurus BLEEKER, Atlas Ichth., V, 1865-69, p. 138, pl. CCXXVII, fig. 1; East Indies, New Guinea.

Monacanthus prionurus GÜNTHER, Cat. Fish., VIII, 1870, p. 234 (copied).

Head $3\frac{1}{4}$; depth $1\frac{1}{5}$; D. I. 26; A. 24. Body somewhat thick, compressed and smooth. Head deep, the snout not protruding much, so that the upper profile line is almost straight to the dorsal; eye high, 2 in snout, 3 in head, and $1\frac{1}{2}$ in interorbital space; jaws equal; teeth pointed; lips rather thin and fleshy; interorbital space flat; gill opening 2 in interorbital space, nearly vertical; not far behind eye, and its distance

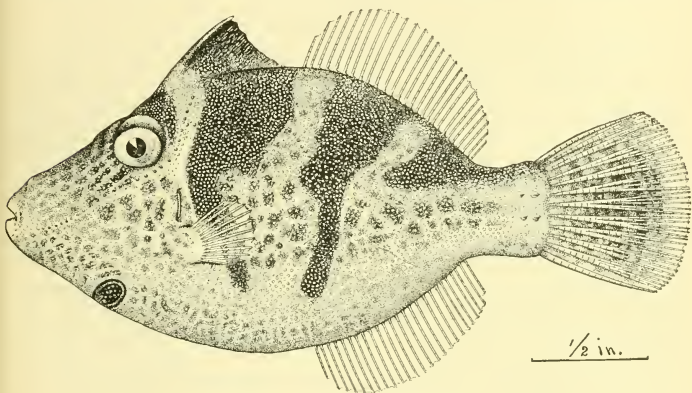


FIG. 6.—PARALUTERES PRIONURUS.

from the same much less its length; dorsal spine a trifle shorter than snout, covered with the skin of the back almost to its tip, its origin much nearer that of the soft dorsal than the tip of the snout, and falling over the posterior part of the eye; origin of soft dorsal a little before that of the anal, and the anterior rays of both fins the longer; longest dorsal rays longer than longest anal rays, and equal to the interorbital space; caudal rounded, the edges obtusely rounded; pectoral short, below the gill opening, and equal to the interorbital space. Caudal peduncle deeper than the length of the pectoral but not equal to the snout; posteriorly and on the sides a bare area in which 4 curved spines are placed in two series.

Color in spirits pale brownish, a band across base of spinous dorsal from eye to eye; 2 broader bands, both narrow, on the sides of the body until level with the eye, when they become broad, extend over the back, the first including the upper half of the spinous dorsal and

region between the two dorsals, and the other not extending on the soft dorsal at all, blackish brown; back blackish brown behind second dorsal band to the base of the upper caudal ray; on the throat a round black spot on each side; head and lower surface of the body marked with various brownish spots and blotches becoming large and few in number on the posterior sides of body; soft dorsal, anal, and pectoral fins plain; caudal plain except indistinct blackish lunate bar from base of upper rays to base of lower and marked with small whitish spots; length $2\frac{5}{16}$ inches. Here described from Wakanoura, from the only specimen of this pretty and interesting little fish taken by us. It differs a little in color from Bleeker's figure, but it is probably the same species.

(*πρίων*, saw; *οὐρά*, tail.)

13. ALUTERA Cuvier.

Les Alutères CUVIER, Règne Anim., 1st ed., 1817, p. 153 (*monoceros*).

Alutera AGASSIZ, Spix, Pisc. Brasil, 1829, p. 137 (*monoceros*).

Aluteria, *Aluterius*, etc., corrected spelling.

Body elongate, strongly compressed, covered with minute scales; snout short, the anterior profile convex; mouth and teeth essentially as in *Monacanthus*, but the lower jaw more projecting, so that the lower teeth are directed obliquely upward and backward. Gill opening an oblique slit, longer than eye, situated below and in advance of eye, its posterior end behind base of pectorals; pelvic bone long, falcate, movable under the skin, without spine at its extremity; dorsal spine small, inserted over the eye, rough, but without barbs; soft dorsal long and anal long, each of 45 to 50 rays; caudal fin short, shorter than head, almost truncate, the middle rays little produced; pectorals small. Size, large.

(*ἄ*, privative; *λυτήρ*, a deliverer; or (according to Duméril), *ἄλουτος*, unwashed, sordid.)

17. ALUTERA MONOCEROS (Osbeck).

Capriscus myrium dentibus minutis KLEIN, Ichth. Missus, III, p. 25, 1742, pl. III, fig. 9; very bad, no locality.

Balistes monoceros OSBECK, Iter Chinensis, 1757, p. 110; China.—LINNÆUS, Syst. Nat., 10th ed., I, 1758, p. 327 (after Osbeck).

Balistes oblongiusculus, etc., GRONOW, Zoophyl., 1765, No. 193; Indian seas.

?*Lija barbuda* PARRA, Dis. Piezas Hist. Nat., 1787, p. 48, pl. XXII, fig. 2; Habana.

Balistes kleinii GMELIN, Syst. Nat., 1788; Indian seas (after Gronow and Klein).

Balistes barbatus WALBAUM, Artedi Piscium, III, 1792, p. 464 (after Klein).

Balistes monoceros var. *unicolor* BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 463 (after Gmelin).

Balistes serraticornis FRÉMINVILLE, Nouv. Bull. Sc. Soc. Philom., No. 67, 1813, p. 249, pl. IV, fig. 1.

Aluteres berardi LESSON, Voyage Coquille, Zool., 1828, p. 108, pl. VII; New Guinea.

Alutera cinerea SCHLEGEL, Fauna Japon., Poiss., 1846, p. 292, pl. CXXXI, fig. 1; Nagasaki.

Alutarius amphacanthus BLEEKER, Verh. Bat. Gen., Balist., XXIV, p. 23, pl. II, fig. 5; East Indies.

Alutarius obliteratus CANTOR, Malayan Fishes, 1850, p. 353; Pinang.

Balistes linguatula GRONOW, Cat., Ed. Gray, 1854, p. 35; Indian seas (after *Balistes oblongiusculus*, etc., of GRONOW).

Aluterus anginosus HOLLARD, Ann. Sci. Nat., IV, 1855, p. 11; East Indies.

Balistes unicornis BASILEWSKY, Nouv. Mém. Soc. Nat. Moscou, X, 1855, p. 263; North China.

Alutarius macracanthus BLEEKER, Verh. Bat. Gen., XXIV, 1852, Balist., p. 22, pl. III, fig. 6; East Indies.

?*Alutera guntheriana* POEY, Proc. Ac. Nat. Sci. Phila., 1863, p. 184; Habana.

Monocanthus monoceros GÜNTHER, Cat. Fish., VIII, 1870, p. 251; Zanzibar, Pinang, Amboyna, China, Japan.—NYSTROM, Svensk. Vet. Handl., 1887, p. 47; Nagasaki.

Alutera monoceros JORDAN and EVERMANN, Fish. N. and M. Amer., II, 1898, p. 1720.

Head $3\frac{3}{5}$; depth $2\frac{2}{5}$; D. I. 49; A. 51. Body oblong, much compressed, and skin with a fine velvety touch. Head very deep, convex both above and below; snout slightly produced upward; eye small, not much above the mouth, 5 in snout, $5\frac{2}{3}$ in head, $1\frac{2}{3}$ in space between its upper margin and origin of spinous dorsal, and 1 in space between its lower margin and upper margin of gill opening; teeth broad, emarginate, the middle mandibular pair pointed; lips thin and narrow, smooth; nostrils small, in front of upper part of eye; gill opening rather long, oblique forward till a little anterior to the nostrils, $2\frac{2}{3}$ in snout and equal to pectoral; origin of spinous dorsal over the anterior edge of eye, and midway between the tip of the snout and the origin of the soft dorsal; soft dorsal and anal with the anterior rays the longer, the longest in both of the fins equal; caudal damaged; pectoral inserted below the mouth and a little behind the middle of the eye; caudal peduncle compressed, equal to one-third the distance from posterior margin of eye to tip of snout.

Color, in alcohol, uniform brown, mottled with darker, and the fins all plain-colored and pale. Here described from a specimen $10\frac{1}{4}$ inches long, obtained by Professor Otaki in the market at Tokyo. Tropical seas, ranging widely, recorded from Cape Cod, throughout the East and West Indies, and from Nagasaki in Japan, where it must be rare. The original *Alutera monoceros* came from China. The American species, *Alutera guntheriana* Poey, will very likely prove different.

(*monoceros*, the unicorn; *μόνος*, one; *κέρας*, horn.)

14. OSBECKIA Jordan and Evermann.

Osbeckia JORDAN and EVERMANN, Check List Fishes N. A., 1896, p. 424 (*scripta*).

This genus is very close to *Alutera*, differing in the longer snout, concave anterior profile, and very long caudal fin, in which the outer rays are much shortened. Size large. From the American genus, *Ceratacanthus*, a very near relative, *Osbeckia* differs in the longer dorsal and anal fins, there being about 36 rays in *Ceratacanthus*.

(Named for Per Osbeck, a pupil of Linnæus and an excellent naturalist, who explored the coasts of China about 1750.)

18. OSBECKIA SCRIPTA (Osbeck).

Unicornu pisces bahamensis (the Unicorn fish) CATESBY, Hist. Nat. Carolina, etc., II, 1737, pl. XIX; Bahamas.

Balistes scriptus OSBECK, Iter Chin., I, 1757, p. 144; China.

Balistes monoceros, var. *scriptus* GÜELIN, Sys. Nat., 1788, p. 1463 (after Osbeck).

Mouacanthus scriptus GÜNTHER, Cat., VIII, 1870, p. 252.

Alutera scripta JORDAN and EVERMANN, Fish. N. and M. Amer., III, 1898, p. 1719.

? *Lija trompa* PARRA, Dis. Piezas Hist. Nat., 1787, p. 46, pl. XXII, fig. 1; Habana.

Balistes laris BLOCH, Ichthyol., IX, 1795, p. 82, pl. ccccxiv; Morocco, Tranquebar.

Balistes ornatus MARION DE PROCÉ, Bull. Soc. Philom., 1822, p. 131; East Indies.

Aluterus parera LESSON, Voy. Coquille, Zool., 1824, p. 106; East Indies.

? *Mouacanthus proboscideus* RANZANI, Nov. Comm. Ac. Sc. Inst. Bonon., 1842, p. 8; Brazil.

Aluterus venosus HOLLARD, Ann. Sc. Nat., 4th ser., IV, 1855, p. 14, pl. 1, fig. 3; New Ireland, Bismarck Archipelago. Coll. Lesson and Garnot.

? *Alutera picturata* POEY, Proc. Ac. Nat. Sci. Phila, 1863, p. 183, Cuba.

Head 3; depth $3\frac{1}{2}$; D. I. 44 to 46; A. 46 to 48. Body oblong, greatly compressed, the depth a little greater than the space between the tip of the snout and the posterior margin of the eye. Head long, its depth equal to space from tip of snout to posterior margin of eye; snout produced upward, the upper profile concave; eye rather small, $3\frac{1}{2}$ to $4\frac{1}{2}$ in snout, 4 to $5\frac{1}{4}$ in head, $\frac{2}{3}$ equal to its diameter to 1 in the space between the upper end of the gill opening and its lower margin, and equal to interorbital space; mouth small; jaws subequal; teeth pointed; lips thin and rather narrow; gill opening beginning before the eye, but not as far forward as the nostril, runs obliquely upward until below the origin of the spinous dorsal. Spinous dorsal over back part of the eye and nearer the tip of snout than the origin of the soft dorsal or else midway between; pectoral inserted level with the anterior margin of the eye, or a little in front of its center, and in the middle of the space between its lower margin and the lower edge of the body; dorsal and anal fins low, the anterior rays of both a little longer than the others, and their origins opposite; caudal long, very long in young, in which it is $2\frac{1}{4}$ in body, and with the median rays much longer than the others; caudal peduncle 2 or a trifle over in head.

Color of young in spirits uniform brownish, many light-bluish curved streaks and spots, some nearly as large as the pupil of the eye; fins, except the caudal, all plain-colored, caudal fin barred with broad, irregular dark-brownish stripes on its basal portion, and with its outer part dark-brownish. Skin fine velvety. Tropical seas, common in East and West Indies alike, occasionally met with on the west coast of Mexico, rare northward. We have received a single small specimen, $5\frac{3}{8}$ inches long, from Kiusiu from Professor Mitsukuri, and a stuffed one, $13\frac{5}{8}$ inches long, from Nagasaki from a local collector. The above description is from these two specimens.

Alutera scripta is probably rare in Japan. The original *scripta* came from China; the American species, *Osbeckia proboscidea* Ranzani, may very likely prove to be different.

(*scriptus*, written, from the form of the markings.)

18. PSEUDALUTERES Bleeker.

Pseudaluteres BLEEKER, Ned. Tyds. Dierk., III, 1865, p. 28 (*nasicornis*).

This genus differs from *Osbeckia* in the small size and anterior insertion of the dorsal spine, which is weak and placed in advance of the orbit.

(*ψευδής*, false; *Alutera*).

19. PSEUDALUTERES NASICORNIS (Schlegel).

Alutera nasicornis SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 223, pl. CXXXI, fig. 2; Nagasaki.—BLEEKER, Nat. Tyds. Ned. Ind., V, 1853, p. 352.

Pseudaluteres nasicornis BLEEKER, Ned. Tyds. Dierk., III, 1865, p. 28.—BLEEKER, Atlas Ichth., V, 1865-69, p. 139, pl. CXXXI, fig. 1; pl. CXXXIV, fig. 2.

Mouucanthus nasicornis GÜNTHER, Cat. Fish., VIII, 1870, p. 254; Zanzibar, Amboina.

Aluteres rhinoceros HOLLARD, Ann. Sci., IV, 1855, p. 19, pl. I, fig. 5.

Depth 3 in length; D. II. 43 to 49; A. 41 to 46. Body oblong, covered with minute rough scales. Snout convex in young males and very convex in adult males; eye $3\frac{2}{3}$ to 4 in head, and $2\frac{1}{2}$ in snout; teeth sharply compressed; the lower emarginate; gill opening arising before the middle of the base of the pectoral, and below the posterior part of the orbit; spinous dorsal before the eye and nostrils, nearly as long as the head, straight and without barbs; soft dorsal and anal low, obtusely rounded, with the origin of the former in advance of the latter; caudal shortly rounded but with the angles acute; pectorals obtusely rounded. Color yellowish or reddish brown; a broad stripe from eye to caudal, like the back, olive or brownish violet; rays of fins yellow or golden, the membranes clear bluish; middle of caudal purplish-blue or brown; eyes yellow; males with 2 narrow bluish bars on sides, the upper through the eye and parallel with the dorsal outline of the back to the base of the last dorsal ray, and the lower from along the abdominal region; body everywhere with small red spots, which run in a series along the bases of soft dorsal and anal. Length $5\frac{1}{2}$ inches. (Schlegel, Bleeker, Günther.)

This little fish, not rare in the East Indies, has been but once recorded from Japan. It was not taken by us.

(*nasus*, nose; *cornu*, horn.)

Suborder OSTRACODERMI.¹

This group includes those Plectognaths which are without spinous dorsal and which have the body inclosed in a 3-angled, 4-angled, or 5-angled box or carapace, formed by polygonal, bony scutes, firmly joined at their edges, and with distinct teeth in the jaws. There is but one family, the *Ostraciidae*, a singular offshoot from the *Sclerodermi*. (*ὄστρακον*, a hard shell, like that of an oyster; *δέρμα*, skin.)

Family IV. OSTRACIIDÆ.

TRUNK FISHES.

Body short, cuboid, triquetrous or pentagonal, covered by a carapace formed of firmly united polygonal bony plates, the jaws, bases of the fins, and caudal peduncle free and covered by smooth skin. Mouth small; each jaw with a single series of long, narrow teeth. Maxillaries and premaxillaries firmly united. Gill opening a nearly vertical slit, below and behind the eye. Dorsal fin single, short, without spine; anal short, similar to dorsal; caudal rounded; no ventral fins; vertebræ 14, the anterior 9 elongate, the last 5 extremely short; no ribs. All are species of the tropical seas, living near the bottom in shallow waters. The species of this group are so singular in appearance and so easily preserved that they have been common in collections ever since the gathering of tropical curiosities began.

a. Carapace forming a continuous bridge behind the anal fin; ventral surface not carinate; caudal rays 10.

b. Body 4-angled, sometimes with an additional median dorsal spine. . . *Ostracion*, 16

aa. Carapace open below behind the anal fin; carapace 6-ridged, a ridge along the middle of each side *Aracana*, 17

16. OSTRACION Linnæus.

Ostracion LINNÆUS, Syst. Nat., 10th ed., 1758; p. 330 (many species; first restricted by Swainson to 4-angled forms, *cubicus* taken as type).

Tetrosomus SWAINSON, Classn. Fish., II, 1839, p. 323 (*turritus*).

Cibotia KAUP, Wiegmann's Archiv. Natur., 1855, p. 214 (*cubicus*).

Lactoria JORDAN and FOWLER, new subgenus (*cornutus*).

Trunk fishes with the carapace closed behind the anal fin; carapace with or without frontal and abdominal spines; dorsal rays 9 or 10; caudal rays always 10; lateral ridges developed; median dorsal ridge undeveloped or else raised with a sharp spine, and the body is therefore 4-angled or 5-angled. Although this character is a striking one, it is not one of high structural importance. Hollard and Bleeker have discarded it as being of no real systematic value. We think, with Dr. Goode, that the shape of the carapace affords "the most reliable

¹This name should be used for the trunk fishes, and not for the *Ostracophori* or extinct mailed allies of *Pterichthys*, for which it has been so frequently taken.

guide in the arrangement of the species of the genus," and we find it difficult to define more than two genera in the family, unless we assign generic rank to each of the leading sections. In Japan three of these sections are represented, *Tetrosomus*, *Lactoria*, and *Ostracion*. The remaining four, *Rhinesomus*, *Chapinus*, *Lactophrys*, and *Acanthostracion*, are all based on the 3-angled species, a type confined to the West Indian Region, and by Jordan and Evermann taken as a distinct genus, *Lactophrys*. This division into 3-angled American species, *Lactophrys*, and 4-angled Asiatic species *Ostracion*, is here accepted.

- a. *Tetrosomus*. Carapace 5-angled, the dorsal ridge surmounted by a very high spine; plates of sides with dark spots *gibbosum*, 20
- aa. Carapace 4-angled; the back without conspicuous central ridge and with a small spine or none, carapace closed behind the dorsal fin.
- b. *Ostracion*. Carapace without spines anywhere; plates of sides with blue spots. *immaculatum*, 21
- bb. *Lactoria*. Carapace with spines, one before each eye being conspicuous.
- c. Frontal spines, short, divergent; center of back with a spine, a small spine opposite it on each lateral ridge; ventral ridge with a spine behind and usually two smaller ones before it; caudal fin moderate; plates somewhat translucent *diaphanum*, 22
- cc. Frontal spines very long, directed forwards; ventral ridge with a long spine behind; a low, blunt spine on back; caudal fin very long in the adult, with black spots *cornutum*, 23

20. OSTRACION GIBBOSUM Linnæus.

Ostracion gibbosus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 331; India (after *Ostracion quadrangulus gibbosus* of Artedi).—GÜNTHER, Cat. Fish., VIII, 1870, p. 258; Zanzibar, Persian Gulf, Borneo, India.

Ostracion turritus FORSKÅL, Descr. Anim., 1775, p. 75; Red Sea.—BLEEKER, Verh. Ak. Wet. I, 1853, p. 15; Kaminoseki, Inland Sea of Japan.—BLEEKER, Atlas Ichth., V, 1865-69, p. 31, pl. III, fig. 3; Java, Celebes, Buro, Amboina, Ceram.—GOODE, Proc. U. S. Nat. Mus., 1879, p. 21, and of most authors.

Lactophrys camelinus DEKAY, New York, Fauna, Fishes, 1842, p. 341, pl. LVIII, fig. 190 (recorded by error from Long Island).

Head 3; depth $1\frac{5}{6}$; D. 9; A. 9; P. 10; scales 9 from gill opening to end of carapace, 11 across widest part of carapace below, and 8 between spine on the back and outermost lateral spine. Eye 2 in head and $1\frac{1}{2}$ in snout; snout obtuse, inferior, very little depressed above; interorbital space concave; mouth small, lips rather thick; teeth small and pointed; nostrils small and directly in front of eye; supraorbital ridge with a well-developed spine. Carapace with 4 ridges, the upper 2 much closer together than the lower ones, along which are 2 low postocular and 4 low posterior spines on each side; median ridge of the back forming a large, compressed, elevated, and triangular spine curving backward; ventral ridges furnished with 5 spines on each side curving backward, the first one of which is small; gill slit short, directly behind the eye; dorsal small, entirely in

advance of the anal, and behind the large spine on the back; caudal, $3\frac{1}{2}$ in the length of the carapace; pectoral large, equal to the snout, which is twice as long as the depth of the caudal peduncle.

Color in alcohol dull brownish, under surface of the carapace plain; sides of body with blackish blotches forming 5 indistinct bars obliquely directed backward; a blackish spot on spine of the back, base of dorsal, caudal peduncle, base of anal; and 2 blackish bars across caudal fin; interorbital region and tip of the snout dark. Length, $1\frac{9}{16}$ inches. Here described from an example from Cavite, Philippine Islands.

This common East Indian species has been once recorded by Bleeker from Kaminoseki in the Inland Sea of Japan. It may be known at once by the hump-like spine on the back. It was not seen by us in Japan.

(*gibbosus*, gibbous.)

21. OSTRACION IMMACULATUM Schlegel.

GINHAGI (SILVER SCRAPER); IIAKO FUGU (BOX PUFFER).

Ostracion immaculatus SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 296; Nagasaki.—BLEEKER, Nalez, Ichth. Japan, 1853, p. 55; Nagasaki.—BREVOORT, Exped. Japan, 1856, p. 284; Shimoda.

Ostracion cubicus ISHIKAWA, Prel. Cat., 1897, p. 3; Misaki.

Head 4; depth $2\frac{1}{5}$; D. 9; A. 9; scales 11 from gill opening to end of carapace, 9 across widest part of ventral region, 7 across widest part of dorsal region, and 7 across widest part of lateral region. Head small; profile in front steep; snout protruding, concave above; mouth low, level with base of pectoral, subinferior; eye high, 3 in head, 2 in snout, and 2 in interorbital space; lips thick and fleshy; teeth rather small and pointed; interorbital space concave; nostrils small. Gill-slit behind eye, in front of pectoral, obliquely vertical, about 2 in head, and with narrow fleshy flap; carapace 4-angled, the edges rounded, and without any spines. Dorsal altogether in advance of the anal, and a trifle higher; caudal long, obtusely convex, about 4 in carapace; pectorals long, equal to dorsal and inferior in position; scales of carapace mostly hexagonal on sides; caudal peduncle rather thick, about equal to eye and gill opening.

Color in alcohol brownish, pale below and dark above, where most of the scales together with those of the sides show traces of a dark spot nearly as large as the pupil; snout dark; fins all plain, with their outermost portion dark; caudal peduncle brownish, darker above, and with traces of dark spots. In life olive with sky-blue spots on the scales of the side. Length of longest example, $7\frac{7}{8}$ inches. Here described from specimens from Hakata, and one from Nagasaki. The largest specimen we have of this species is from Wakanoura, and is $8\frac{3}{8}$ inches long.

This trunkfish is common in the bays washed by the Kuro Shiwo from

Tokyo southward. Our numerous specimens are from Tokyo, Misaki, Aburatsubo (Sagami), Enoshima, Wakanoura, Hakata, and Nagasaki.

It is probably a subspecies of *Ostracion tuberculatum*¹ (cubicum), as Bleeker has indicated, or even it may be the same species with it, as Günther regards it. We give it provisional rank as a distinct species because all our specimens are deeper in body than *O. tuberculatum*; none of them show any of the black spots characteristic of that species, and in our experience very few of the fishes permanently resident along the coast of Japan are exactly identical with the cognate species of the East Indies. The absence of frontal and dorsal spines at once distinguishes this from the other Japanese trunk-fishes.

(*immaculatus*, unspotted.)

22. OSTRACION DIAPHANUM Bloch and Schneider.

O. UMITSUZUME (BIG SEA SWALLOW); SUZUMEFUGU (SWALLOW PUFFER).

Ostracion diaphanum BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 501; no locality.—BLEEKER, Act. Soc. Sci. Indo-Nederl., III, 1857, Japan, IV, p. 38.—HOLLARD, Ann. Sci. Nat., 1857, VIII, p. 157.—GÜNTHER, Cat. Fish., VIII, 1870, p. 264; Cape of Good Hope, Japan.—ISHIKAWA, Prel. Cat., 1897, p. 3; Kagoshima, Sagami (one specimen wrongly called *O. fornasini*).

Ostracion brevicornis SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 297, pl. cxxx, fig. 3; Nagasaki.

Ostracion undecimaculeatus SMITH, Ill. Zool. S. Afr., 1838-42, pl. xvii; Cape of Good Hope.

Ostracion pentacornis BENNETT, Whaling Voyage, 1839, p. 266.

Ostracion cornutus BLEEKER, Atlas Ichth., V, 1865-69, p. 33, pl. II, fig. 2; pl. IV, fig. 3, Amboyna, Nagasaki (not of Linnaeus, according to Peters, Berlin, Monat. Ak. Wiss. Berlin, 1868, p. 461).

Head 4; depth 2½; D. 9; A. 9; scales 10 from gill opening to end of carapace, 12 across greatest ventral width, and 8 in a series from dorsal spine to ventral keel. Body moderately long, heavy forward, broader than deep, and convex below. Carapace with 4 ridges, the

¹The following are the chief synonyms of *Ostracion tuberculatum*:

Ostracion tetragonus LINNÆUS, Mus. Adolph-Frederik, 1759, p. 59; India (date prior to 1758, the recognized beginning of binominal nomenclature).

Ostracion tuberculatus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 331; India (after Artedi, p. 84; no species; back with 4 tubercles).

Ostracion cubicus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 331; India (after *Ostracion tetragonus* Günther, Cat. Fish., VIII, 1870, p. 260, and of authors generally).

Ostracion bituberculatus BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 501; Pacific Ocean (after Lacépède).

Ostracion argus RÜPPELL, Atlas Fische, 1828, p. 4, pl. I, fig. 2; Red Sea.

Ostracion cyanurus RÜPPELL, Atlas Fische, 1828, p. 4, pl. I, fig. 2; Red Sea.

Ostracion tesseralis BLEEKER, Nat. Tyds. Ned. Ind., III, 1852, p. 305; Mouloua (not of Cantor).

Ostracion tetragonus BLEEKER, Atlas Ichth., V, 1865, p. 39, pl. III, fig. 2; Java, Sumatra, Singapore, Celebes, Amboyna, etc.

greatest width of the dorsal fin equal to one-fourth the length of the carapace; a supraocular spine pointing forward and a small spine in the middle of the dorsal ridge on each side, and at the same point as the latter a large spine somewhat curved backward in the middle of the back; ventral ridges terminating in a strong spine, and on each side between its base and the base of the pectoral fin are 2 small spines at equal distances. Head deep, profile above steep, convex, and with snout projecting; mouth below gill opening small, with small pointed teeth; lips thick and fleshy; eye high, 2 in snout, $2\frac{3}{5}$ in head, and $1\frac{3}{5}$ in interorbital space; interorbital space concave; gill opening short, one-half in eye and posterior to it; base of the dorsal at the last fourth of the carapace higher than anal; origin of anal midway between base of last dorsal ray and end of carapace; caudal equal to space from origin of dorsal to end of carapace, the lower rays the longer, and its edge oblique; pectoral with upper rays the longest and equal to snout; caudal peduncle rather thick, 2 in snout.

Color in alcohol brownish, lighter below, and with many black spots all over the upper surface, small on the back and large on the posterior and lateral parts; some few dark spots at the margins of the ventral ridges; fins pale; caudal peduncle dark above, with several dark spots; a dark spot at base of pectoral and one on caudal peduncle below at base of lower caudal ray. Length $4\frac{1}{2}$ inches. In a small specimen, $1\frac{3}{4}$ inches in length, the spines are much longer and stronger, though absent from the ventral ridges, except the last one on each side; snout projecting considerably; gill opening very small, color with spots mostly replaced by narrow, dark, curved lines. Here described from Misaki specimens. It was not taken elsewhere by us.

This species, common throughout the East Indies, ranges occasionally northward in the Kuro Shiwo to Japan. We have a single large example from Misaki, and Bleeker records this fish from Nagasaki. The species is readily known by its short frontal spines and the translucent carapace.

(*diaphanus*, translucent.)

23. OSTRACION CORNUTUM Linnæus.

KONGOFUGU (ADAMANT-PUFFER).

Ostracion cornutus LINNÆUS, Syst. Nat., 10th ed., 1758, I, p. 231; India.—SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 299, pl. cxxxI, fig. 4; Nagasaki.—GÜNTHER, Cat. Fish., VIII, 1870, p. 265; Natal, Zanzibar, Seychelles, Pinang, Siam, India, China, Fiji, New Guinea.—NYSTRÖM, Svensk. Vet. Handl., 1887, p. 47; Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 3; Misaki.

Ostracion arcus BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 502 (after *Ostracion quadrangulatus* of Seba).—BLEEKER, Atlas Ichth., V, 1865-69, p. 35, pl. II, fig. 3; pl. IV, fig. 2; Java Cocos, Sumatra, Celebes, Terrate, Ceram, etc.—GOODE, Proc. U. S. Nat. Mus., 1879, p. 282.

Ostracion valentini, BLEEKER, Journ. Ind. Archip., 1848 (very young).

Head $3\frac{1}{3}$ to 4; depth $2\frac{1}{3}$ to $2\frac{2}{3}$; D. 9; A. 9; scales on side of carapace 9 or 10; across widest part of ventral surface 7; and from ventral keel to middle of back 7 or 8. Head deep, the profile in front very steep, nearly vertical; snout projecting $1\frac{1}{2}$ in head and $1\frac{1}{2}$ across forehead; eye high, $1\frac{1}{2}$ in head and $1\frac{1}{2}$ across forehead; interorbital deeply concave; eye about equal to its distance from gill slit in small examples and greater in large ones; mouth small, inferior; lips very thick and fleshy; teeth small, narrow, and pointed; carapace 4-angled, and in the middle of the back an inconspicuous median keel; a pair of sharp, pointed, anterior, supra-orbital spines; in the small specimens very long and the adults shorter, pointing out forward; dorsal ridges not conspicuously marked except about the low, blunt, median spine, on each side before the dorsal fin; a similar spine to the lateral dorsal spines, and between them on the back; ventral ridges plain, and terminating in a strong spine projecting backward, which is very much longer in young specimens; dorsal fin considerably in advance of anal and higher; anal beginning about midway between origin of dorsal and base of caudal; caudal very long, $1\frac{1}{2}$ to $2\frac{1}{2}$ in body, the edge convex and distally expanded; pectoral short, about equal to snout, and the upper rays the longest. Gill slit small, much less than eye.

Color in spirits brownish; almost all the scales above and on sides marked with dark brownish spots above and on sides; caudal peduncle above with round, dark-brown spots; above caudal with several round, large blackish-brown spots, the upper and lower parts of the fin darker than the center; dorsal, anal, and pectoral plain; snout dark, blackish-brown; lips pale. Largest specimen, $7\frac{1}{2}$ inches. Two very small specimens have the dorsal and ventral ridges very pronounced, a deep, short body, the sides and upper surface strongly striated, and the caudal short, and its base rather high. Here described from Misaki specimens. It was not taken by us elsewhere in Japan. It is common in the East Indies, and we have numerous examples from Manila.

(*cornutus*, horned.)

17. ARACANA Gray.

Aracana GRAY, Ann. Nat. Hist., I, 1838, p. 110 (*auritus*).

Acerana KAUP, Wiegmann's Archiv., 1855, p. 219 (same type?).

Capropygia KAUP, Wiegmann's Archiv., 1855, p. 220 (*unistriata*).

Kentocapros KAUP, Wiegmann's Archiv., 1855, p. 220.

Anoplocapros KAUP, Wiegmann's Archiv., 1855, p. 221 (*grayi*).

This genus differs from *Ostracion* in having the carapace open behind the anal fin. The species vary in form almost as much as do those of *Ostracion*. The single Japanese species belongs to the subgenus *Capropygia*, having spines on the ridges but none above the eye. In *Aracana* proper there are spines over the eye, and the abdomen is crested, while in *Anoplocapros* the back and belly are crested, but no spines are present anywhere.

(*aracana*, a meaningless name.)

24. ARCANA ACULEATA (Houttuyn).

ITOMAKI FUGU (REAL PUFFER).

Ostracion aculeatus HOUTTUYN, Verh. Holl. Maats. Wet. Haarlem, XX, Pt. 2, 1782, p. 346; Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 3; Sagami.

Arcana aculeata GÜNTHER, Cat. Fish., VIII, 1870, p. 266; Japan.

Ostracion hexagonus THUNBERG, Vet. Ac. Nya Hyndl., XI, 1790, p. 107, pl. 11; Japan ("Veneni suspectus et in cibo damnatus").—BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 502 (copied).

Ostracion stictonotus SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 297, pl. CXXXI, fig. 3; Nagasaki.—BLEEKER, Verh. Ak. Wet., I, 1853, Japan, p. 15; Nagasaki.—NYSTROM, Svensk. Vet. Handl., 1887, p. 48; Nagasaki.

Head $3\frac{1}{2}$ to $3\frac{3}{4}$; depth 2 to $2\frac{1}{5}$; D. 10 to 11; A. 10; scales 8 or 9 in a series from gill opening to end of carapace, 8 across widest part of ventral surface, and 8 or 9 from middle of back to ventral ridge; scales all roughly striated; carapace strong, with 6 ridges; the dorsal fin with a broad, strong, compressed spine about halfway between the posterior margin of eye and origin of dorsal; the lateral ridges a little superior and on the posterior half of the carapace, and 2 broad, flattened spines on each side under the dorsal; ventral ridges each with a median, broad, flattened spine, posterior to the dorsal spine, and terminated finally in a more rounded posteriorly directed spine. The head is very deep, profile obliquely straight above to the tip of the snout; snout inferior, protruding little; mouth small; teeth small, narrow, and pointed; jaws subequal, lips very thick, fleshy, and papilose; eye high, large, $1\frac{2}{3}$ in snout, $2\frac{1}{2}$ in head, $1\frac{1}{2}$ in forehead between eyes; nostrils small in front of eye; gill opening below the middle of the eye, from one-half to two-thirds the diameter of the eye, and greater than the space between the lower margin of the eye to its upper end; origin of dorsal only a short distance in advance of that of the anal, and also higher than the same; caudal broad and slightly convex, the edges sharp; pectoral equal to snout, the outer ray the longest, the others graduated to the innermost, which is one-half the length of the outer; caudal peduncle rather thick, its least depth from one-half to two-thirds the length of the eye.

Color of the body brown, darker above, and on the back and upper parts of the sides with many blackish-brown spots nearly as large as the pupil; fins all plain; snout brownish above. Length of largest specimen $5\frac{1}{2}$ inches. Here described from Nos. 2372, 2377, 2378, and 2382, dredged by the U. S. Fish Commission steamer *Albatross* in Sagami Bay.

This little trunk fish is rather common at moderate depths in the waters of southern Japan, not having yet been seen elsewhere. Our specimens are from Misaki and from Sagami and Suruga bays, where they were dredged by the U. S. Fish Commission steamer *Albatross*.

(*aculeatus*, with needle-like spines).

SUMMARY.

SCLERODERMI.

Family I. TRIACANTHIDÆ.

1. *Triacanthodes* Bleeker.
1. *anomalous* (Schlegel).
2. *Triacanthus* Cuvier.
2. *brevirostris* Schlegel.

Family II. BALISTIDÆ.

3. *Pachyura* Swainson.
3. *capistratum* (Shaw); Wakanoura, Okinawa.
4. *conspicillum* (Bloch and Schneider); Urakawa.
4. *Pseudobalistes* Bleeker.
5. *flavimarginatus* (Rüppell); Wakanoura.
5. *Balistapus* Tilesius.
6. *undulatus* (Park).
7. *aculeatus* (Linnæus); Okinawa.

6. *Canthidermis* Swainson.

8. *rotundatus* (Procé).

Family III. MONACANTHIDÆ.

7. *Monacanthus* Cuvier.
9. *chinensis* (Osbeck).
8. *Stephanolepis* Gill.
10. *cirrhifer* (Schlegel); Tokyo, Misaki, Totomi Bay, Onomichi, Wakanoura, Kobe, Tsuruga, Hakata, Nagasaki.
11. *japonicus* (Tilesius); Nagasaki.
12. *oblongus* (Schlegel); Nagasaki.
9. *Pseudomonacanthus* Bleeker.
13. *modestus* (Günther); Otaru, Hakodate, Aomori, Tokyo, Misaki, Tsuruga, Kobe, Onomichi, Hiroshima, Hakata, Nagasaki.
10. *Rudarius* Jordan and Fowler.
14. *ercodes* Jordan and Fowler; Tokyo, Yokohama, Misaki, Tsuruga, Wakanoura, Onomichi, Nagasaki.
11. *Brachaluteres* Bleeker.
15. *ulvarum* Jordan and Snyder; Misaki.
12. *Paraluteres* Bleeker.
16. *prionurus* Bleeker; Wakanoura.
13. *Alutera* Cuvier.
17. *monoceros* (Osbeck); Tokyo.
14. *Osbeckia* Jordan and Evermann.
18. *scripta* (Osbeck); Kiusiu, Nagasaki.
15. *Pseudaluteres* Bleeker.
19. *nasicornis* (Schlegel).

OSTRACODERMI.

Family III. OSTRACIDÆ.

16. *Ostracion* Linnaeus.

20. *gibbosum* Linnaeus.

21. *immaculatum* Schlegel; Tokyo, Misaki, Aburatsubo, Enoshima, Wakanoura, Hakata, Nagasaki.

22. *diaphanum* Bloch and Schneider; Misaki.

23. *cornutum* Linnaeus; Misaki.

17. *Aracana* Gray.

24. *aculeata* (Houttuyn); Misaki, Sagami Bay, Suruga Bay.

BIRDS COLLECTED BY DR. W. L. ABBOTT AND MR. C. B. KLOSS IN THE ANDAMAN AND NICOBAR ISLANDS.

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The following list is based on a collection numbering about 520 specimens, obtained at various points in the Andaman and Nicobar islands by Dr. W. L. Abbott and Mr. C. B. Kloss, during the months of January, February, and March, 1901. Most of this time was devoted to the less-known islands of the last-named group, particularly Great and Little Nicobar, as the Andamans have recently been more or less thoroughly explored by Mr. A. L. Butler, who has published the results of his work¹ in a journal inaccessible to me.

The collection forwarded to the United States National Museum by Dr. Abbott contains nearly 100 species, of which 9 appear to be new, namely: *Zosterops ventralis*, *Sturnia erythropygia katchalensis*, *Rhinomyias nicobarica*, *Arachnechthra klossi*, *Pitta abbotti*, *Spilornis klossi*, *Astur obsoletus*, *Osmotreron chloroptera andamanica*, and *Ercalactoria trinkutensis*.

All of the specimens are supplied with accurate data, in addition to which the collector has sent notes, in some cases quite extensive, on the habits and distribution of the various species.

Hume's elaborate paper on the birds of these islands² gives in detail the topography and physical characteristics of the two groups, and it is unnecessary here to more than mention the localities visited by Messrs. Abbott and Kloss.³

These are as follows: Barren Island, January 6 and 7; Henry Lawrence Island (anchored in Kwantung Strait), January 8 to 11; MacPherson Strait, between South Andaman and Rutland islands (including adjacent mainland), January 14 to 17; North Cinque Island, January 18; Little Andaman (Bumila Creek, at the north end of the island),

¹Journal of the Bombay Natural History Society, XII, 1899.

²Stray Feathers, II, 1874, pp. 1-324, with map.

³See also a paper by Mr. G. S. Miller, jr., on the mammals collected by Dr. Abbott, in these Proceedings, XXIV, 1902, pp. 751-795, with map.

January 19 and 20. In the Nicobars, Car Nicobar (Mus, a village on the northern peninsula of the island), January 21 to 27; Tillanchong (a bay on the west side, at foot of Maharani Peak), January 29 to February 1; Trinkut (in Beresford Channel, at southwest corner of the island), February 1 to 5; Nankauri and Kamorta (Nankauri Harbor and neighborhood), February 5 to 11; Kamorta (Dring Harbor, west coast), February 11 to 15; Katchal (West Bay), February 16 to 24; Little Nicobar (anchorage back of Pulo Milu), February 25 to March 4; Great Nicobar (bay southeast of Pulo Kondul, March 5 to 10; Ganges Harbor, March 10 to 16; Pulo Kunyi, March 17 to 21; Pulo Nyer, March 21 to 24; Pulo Rotan, March 24 to 26; Galathea Bay, March 27 to 30), March 5 to 30.

The sequence of species followed in the present list is that of the "Fauna of British India" (Blanford and Oates).

Measurements are given in millimeters, and have been taken from the dried specimens, except that of total length, which in all cases has been supplied by the collector from the fresh bird.

Family CORVIDÆ.

CORVUS MACRORHYNCHOS Wagler.

C[orvus] macrorhynchus WAGLER, Syst. Avium., I, 1827 [p. 313] (Sumatra and Java).

"Pretty common at Lawrence Island and South Andaman." Three specimens were obtained on the first-named island. The total length, as given on the labels, varies from 482.5 mm. to 508 mm.¹

Family ZOSTEROPIDÆ.

ZOSTEROPS PALPEBROSA NICOBARICUS (Blyth).

Z[osterops] nicobaricus BLYTH, Journ. Asiat. Soc. Bengal, XIV, Pt. 2, 1845, p. 563 (Nicobars).

"Common in Car Nicobar, less so in Trinkut, Kamorta, and Katchal. Not observed in the southern islands (Great and Little Nicobar)." In the Andamans it was found to be "common on North Cinque," and on Barren Island it was "the commonest bird."

This form is readily distinguished from *Z. palpebrosa* by its longer bill, shorter tail, and generally lighter color above.² The total length ranges from 108 mm. to 120.5 mm., the smallest examples being from Car Nicobar, and the largest from the Cinque Islands.

ZOSTEROPS VENTRALIS, new species.

Type.—Adult female, No. 178798 U.S.N.M.; Car Nicobar, January 24, 1901; Dr. W. L. Abbott. Entire upper parts, including sides of

¹The collector's measurements have been reduced from inches to millimeters.

²See also Hume, Stray Feathers, II, 1874, p. 242.

head and neck, and edges of wing feathers, olive green, the outer webs of basal half of tail feathers edged with the same color; tail and wing feathers clove brown; cheeks and throat olive yellow; breast, sides of body, thighs, and flanks, pale smoke gray; center of abdomen and under tail-coverts, canary yellow; lores and feathers under eye black; a narrow ring of feathers round the eye, white; under wing-coverts and axillaries, white; inner webs of wing feathers white on under surface.

Length (of fresh specimen), 111 mm.; wing, 53; tail, 37.5; tarsus, 15; culmen, 11.5 (bill from gape, 15) mm. "Iris brown, bill and feet plumbeous."

The single individual obtained differs from *Z. aureiventris* in its darker yellow throat, darker sides and upper parts, and uniformly darker plumage.

Family PYCNONOTIDÆ.

IRENA PUELLA (Latham).

[*Coracias*] *puella* LATHAM, Index Orn., I, 1790, p. 171 (India).

One specimen only, a male from Henry Lawrence Island. Length of the fresh bird, 254 mm. "Iris red." It was also observed on South Andaman.

OTOCOMPSA EMERIA (Linnæus).

[*Motacilla*] *emeria* LINNÆUS, Syst. Nat., 10th ed., I, 1758, p. 187 (Benghala).

"Introduced. Common about the old convict settlement on Kamorta; a few seen at Dring Harbor, same island." Two skins are in the collection from this island, and a third from Nankauri. At the Andamans it was "common on South and Little Andaman." Nine specimens were collected, of which five are from the Cinque Islands.

In plumage the birds from the Andamans and Nicobars are alike, but differ from Indian and Malay peninsula examples in being rather darker and browner above, with more extensive white tips on the rectrices. The Andaman birds have somewhat larger bills than those from other localities. The total length of birds in the flesh varies from 178 mm. to 203 mm.

IOLE NICOBARIENSIS (Moore).

Hypsipetes nicobariensis MOORE, in Horsfield and Moore, Catal. Birds Mus. East India Co., I, 1854, p. 257 (Nicobars).

"Common in the central group of islands, Tillanchong, Trinkut, Nankauri, Kamorta, and Katchal. Not seen elsewhere. It occasionally congregates in assemblies of 50 or more, in some large tree, where they make a great chattering and uproar."

Thirteen specimens.

The total length, in the flesh, ranges from 216 mm. to 228.5 mm.

"Iris, brown; feet, greenish brown; bill, olive green, with yellow edges."

MICROTARSUS FUSCOFLAVESCENS (Hume).

Brachypodius fuscoflavescens HUME, Stray Feathers, I, 1873, p. 297 (S. Andaman).

One adult male, from South Andaman. "Iris, blue; feet, leaden blue; bill leaden, blackish at tip. Several seen." Length, 178 mm.

Family DICRURIDÆ.

DISSEMUROIDES ANDAMANENSIS (Beavan).

Dicrurus andamanensis "TYTLER," BEAVAN, Ibis, 1867, p. 323 (Andamans).

"Common on South and Little Andaman."

Six specimens. Length ranges from 292 mm. to 343 mm.

DISSEMURUS MALABARICUS (Scopoli).

Muscicapa (malabarica) SCOPOLI, Del. Flor. Faun. Insub., II, 1786, p. 96 ("China").

"Common in Great and Little Nicobar, less so in Katchal; none seen elsewhere. Frequents heavy forest, and is very easily 'called up.'"

Seven specimens, from the above-mentioned islands.

Hume has already referred¹ to the large crests of the Nicobar birds (which are almost identical with examples from the Mergui archipelago), as compared with those of the Andamans. This feature is so prominent that I do not hesitate to keep the two forms apart, but as to the right of the Nicobar bird to bear the name *malabaricus* I am not so certain.

The above specimens vary from 428.5 mm. to 558.5 mm. in total length.

DISSEMURUS MALABARICUS OTIOSUS, new name.

"Observed on Lawrence Island and Little Andaman."

Four skins, representing the above localities; those from Little Andaman are intermediate between this form and *D. malabaricus*, but are much nearer the former.

Total length of birds in the flesh ranges from 489 to 527 mm. This form, originally called *Edolius affinis*,² will require a new name, as there is an earlier *E. affinis*.³

¹Stray Feathers, II, 1874, p. 213.

²Beavan, Ibis, 1867, p. 323.

³Blyth, Journ. Asiatic Soc. Bengal, XI, 1842, p. 174.

Family SYLVIIDÆ.

LOCUSTELLA CERTHIOLEA (Pallas).

Motacilla certhiola PALLAS, Zoogr. Rosso-Asiat., I, 1811 (1826), p. 509 (region beyond lake Baikal):

One male, from Kamorta, collected February 10. "Iris, brown; legs, flesh-colored; feet and claws, pale brownish olive."

Apparently no previous record for the Nicobars.

CISTICOLA CISTICOLA (Temminck).

Sylvia cisticola TEMMINCK, Mamel d'Orn., 2d ed., I, 1820, p. 228 (Portugal).

Four specimens, all from Trinkut. "Common in the grassy lands of Trinkut, Kamorta, and Nankauri."

CISTICOLA, species.

On Great Nicobar a small bird, supposed to be a species of *Cisticola*, was found to frequent the grassy plains in the southern part of the island, along the upper Galathea River, but Messrs. Abbott and Kloss were so hurried in their trip up this river that no specimens were obtained.

ACANTHOPNEUSTE BOREALIS (Blasius).

Phyllopneuste borealis H. BLASIUS, Naumannia, 1858, p. 313 (Helgoland).

One adult, from Little Andaman.

ACANTHOPNEUSTE TENELLIPES (Swinhoe).

Phylloscopus tenellipes SWINHOE, Ibis, 1860, p. 53 (Amoy, China).

A single adult male was captured at sea about 10 miles east of Great Nicobar. It flew on board the vessel, April 1.

This species appears not to have been hitherto recorded from the Nicobars.

ACANTHOPNEUSTE LUGUBRIS (Blyth).

Phyllopneuste lugubris BLYTH, Ann. Mag. Nat. Hist., XII, 1843, p. 98 (near Calcutta).

Two specimens from Henry Lawrence Island, and one from MacPherson Strait, South Andaman.

Family LANIIDÆ.

LANIUS LUCIONENSIS (Linnæus).

[*Lanius*] *lucionensis* LINNÆUS, Syst. Nat., 12th ed., I, 1766, p. 135 (Luzon).

A male was shot at MacPherson Strait, South Andaman, and a female was obtained at Car Nicobar.

Family CAMPEPHAGIDÆ.

PERICROCOTUS ANDAMANENSIS Beavan.

Pericrocotus andamanensis "TYTLER," BEAVAN, Ibis, 1867, p. 322 (Andamans).

One specimen each from South Andaman and Henry Lawrence Island. "Shot in thick forest."

GRAUCALUS DOBSONI Ball.

Graucalus dobsoni BALL, Journ. As. Soc. Bengal, XLV, Pt. 2, 1872, p. 281 (Andamans).

Two specimens, male and female, are in the collection, from South Andaman, and a number of others were seen. The iris is noted as dark brown. Length of the female, 305 mm. The wing in the male is 170 mm.; in the female, 172.5 mm.

Family ORIOLIDÆ.

ORIOLOUS MACROURUS Blyth.

O[riolus] macrourus BLYTH, Journ. As. Soc. Bengal, XV, 1846, p. 46 (Nicobars, central group).

Fourteen specimens, from Trinkut, Kamorta, and Great and Car Nicobar. "Common in all the islands visited."

ORIOLOUS ANDAMANENSIS Beavan.

Oriolus andamanensis "TYTLER," BEAVAN, Ibis, 1867, p. 326 (Andamans).

Eleven specimens, collected in South Andaman, Henry Lawrence, Cinque Islands, and Little Andaman. It was reported to be "common at all collecting places."

Family EULABETIDÆ.

EULABES ANDAMANENSIS Beavan.

Eulabes andamanensis "TYTLER," BEAVAN, Ibis, 1867, p. 331 (Andamans).

"Common in Great and Little Nicobar, also seen in Katchal, and a few in Kamorta." It was observed on South Andaman, and a female was obtained on Rutland Island. The latter measures: Total length, 305 mm.; wing, 165 mm. "Bill and wattles reddish orange; feet yellow."

A male from Little Nicobar measures, in the flesh, 324 mm.; wing, 183 mm. "Iris, brown; feet, Indian yellow; wattles, bright yellow; bill, orange red, with yellow tip."

Males from Katchal have wings varying from 170.5 mm. to 177.5 mm.

CALORNIS TYTLERI Hume.

Calornis tytleri HUME, Stray Feathers, I, 1873, p. 480 (Port Mouat, South Andaman).

Twenty specimens from various islands in the Nicobar group. In total length these examples vary from 203 mm. to 228.5 mm.

"Found in all the islands visited. The color of the iris varied; all of those shot in Car Nicobar had brown irides, and all shot in the central group, Trinkut, etc., had white irides. It was certainly not the result of age or sex." The birds from Great and Little Nicobar are also marked as having white irides. (On this point see Hume¹).

Family STURNIDÆ.

STURNIA ANDAMANENSIS (Beavan).

Temenuchus andamanensis "TYTLER," BEAVAN, Ibis, 1867, p. 329 (Andamans).

"Common at South Andaman and North Cinque."

Six examples from the above localities are in the collection.

Length in fresh birds varies from 222 to 228.5 mm. Apparently not seen in the Nicobars.

STURNIA ERYTHROPYGIA Blyth.

Sturnia erythropygia BLYTH, Journ. As. Soc. Bengal, XV, 1846, p. 34 (Nicobars).

"Common in Car Nicobar, going about in flocks with *Calornis tytleri*. Especially frequents the cocoanuts and casuarinas. Not seen elsewhere."

Seventeen specimens of this rare species were obtained, all from Car Nicobar. Males measure 228.5 to 237 mm. in total length; females, from 222 to 251 mm.

Colors of fading parts, as mentioned on the labels, are: Iris, pale blue to china white; bill greenish yellow, base chalky cobalt; feet dull yellow to ochraceous; claws pale horny yellow.

STURNIA ERYTHROPYGIA KATCHALENSIS, new subspecies.

Sturnia erythropygia appears to be confined to the island of Car Nicobar. The Hume party found it only on that island, and Dr. Abbott did not meet with it elsewhere. *S. andamanensis*, according to both Hume and Davison, was found on the Nicobars only at Kamorta, but Dr. Abbott does not mention it from this group in his notes on the birds observed there. Hume, in referring to the occurrence of *S. andamanensis* in the Nicobars, says:²

I cannot feel at all certain that this species is indigenous in the Nicobars. We never saw it anywhere except in the immediate neighborhood of the settlement at Kamorta, at which station I understand that some twenty were let loose many years ago, having been brought down from Port Blair, where this species swarms. Even at Kamorta it is far from plentiful, and it does not seem at present to extend to any of

¹ Stray Feathers, I, 1873, p. 480.

² Stray Feathers, II, 1874, p. 249.

the closely adjacent islands of Nankauri, Katchal, or Trinkut, all of which Davison very thoroughly worked, or, indeed, even to the northernmost portion of Kamorta itself.

At the present day, not thirty years after Hume's notable trip, there exists on the island of Katchal a form of *Sturnia* which combines the characters of both *S. andamanensis* and *S. erythropygia*; whether this is a descendant of the birds liberated on Kamorta years ago, and originally from the Andamans, or a form long resident on Katchal and overlooked by previous collectors, is more than I am at present able to explain. It seems more probable, however, that the Katchal bird has been derived from the Kamorta stock and has become fairly numerous within recent years. It is not likely that Hume or Davison would have overlooked a bird of this character had it existed on the island in 1873. As to the bird of Kamorta, does it now occur there, and is it still *andamanensis*? Hume would have called attention to it had it differed from true *andamanensis* at the time of his visit. Dr. Abbott did not see any traces of it there during his recent trip.

The new form may be described as follows:

Type.—Adult male, No. 178629, U.S.N.M.; Katchal, Nicobars, February 20, 1901; Dr. W. L. Abbott. Whole head, neck, breast, sides, and upper abdomen white, with a slight grayish wash on crown; back, pale smoke gray, somewhat lighter on scapulars and passing into wood brown on the rump and upper tail-coverts; lower abdomen, under tail-coverts and flanks russet; thighs wood brown anteriorly, smoke gray behind. Wings, black, with metallic green reflections, most pronounced on coverts and secondaries; under wing-coverts and axillaries pure white; concealed bases of outer primaries and basal third of quill of second primary, white. Tail, black above, with metallic reflections as on wings; outermost pair of feathers russet on exposed portion of outer webs and for about 20.5 mm. on inner webs; the other rectrices tipped with russet, the tips becoming narrower toward the middle pair, which are merely edged with this color. Length, 219 mm.; wing, 106; tail, 71; tarsus, 25.5; culmen, 21.5. "Iris pale blue; bill yellow, base blue; feet ochraceous." Two females measure 209.5 mm. in total length.

The six skins of this form all differ from *S. erythropygia* in having the pale rump and upper tail-coverts of *S. andamanensis*, with the smaller dimensions of the latter.

ACRIDOTHERES TRISTIS (Linnæus).

[*Paradisea*] *tristis* LINNÆUS, Syst. Nat., 12th ed., I, 1766, p. 167 ("Philippinis").

One adult female, from Kamorta.

"Introduced. Only met with about the abandoned settlement at Nankauri Harbor, where they were pretty numerous."

Evidently of recent appearance in this locality, as Oates says¹ that it "does not extend to the Nicobars."

¹Fauna Brit. India (Birds), I, 1889, p. 537.

Family MUSCICAPIDÆ.

MUSCITREA GRISOLA (Blyth).

T[ephrodoris] grisola BLYTH, Journ. As. Soc. Bengal, XII, Pt. 1, 1843, p. 180* (near Calcutta).

Six specimens, from Henry Lawrence Island, Barren Island, South Andaman, and Cinque Islands.

ALSEONAX LATIROSTRIS (Raffles).

Muscicapa latirostris RAFFLES, Trans. Linn. Soc. Lond., XIII, Pt. 2, 1822, p. 312 (Sumatra).

Five specimens, from South Andaman, Barren, Rutland, and Cinque islands.

TCHITREA NICOBARICA (Oates).

Terpsiphone nicobarica OATES, Fauna Brit. India (Birds), II, 1890, p. 48 (Andamans and Nicobars).

“Not met with in Car Nicobar or Tillanchong, but fairly common in all the other islands. Adult males, white ones, seen only in Great and Little Nicobar.”

Eleven specimens, mainly from Katchal; one specimen each from Kamorta, Nankauri, and Trinkut, and two males in white plumage from Great Nicobar. The latter differ from the corresponding phase of *T. affinis* only in the central tail feathers, which are much broader near the tips. The young males resemble the female, lacking the glossy blue-black throat and sides of head of older birds.

The white males from Great Nicobar each measure 451 mm. in total length; the fresh colors, as stated on the labels, are: “Iris, dark brown; orbital skin, blue; bill, blue, tip and commissure, black; feet, leaden blue.”

A Katchal female has a total length of 293 mm.; another from the same island measures 186.5 mm.

RHINOMYIAS NICOBARICA, new species.

Type.—Adult male, No. 178740, U.S.N.M.; Pulo Kunyi, Great Nicobar, March 20, 1901; Dr. W. L. Abbott. Top of head, back, scapulars, and rump, brown (between bistre and raw umber), brightest on the back; upper tail-coverts and tail burnt umber; wings dark brown, the feathers edged with the color of the back, lighter on the primaries and burnt umber on the secondaries. Lores, and feathers about eyes, buff; cheeks, ear-coverts and sides of neck similar to the crown, but lighter, the ear-coverts with light shaft streaks; throat and abdomen, white; breast with a narrow band of wood brown (feathers of the breast buffy white, edged with wood brown); sides and flanks wood brown, the thighs drab; under tail-coverts, axillars

and under wing-coverts deep buff, the latter darker along edge of wing; inner webs of wing feathers with light buffy edges. Wing, 77.5 mm.; tail, 61; tarsus, 18; culmen, 14 (bill, from gape, 22). Length, 165 mm. "Iris, dark brown; feet, pale brownish fleshy; upper mandible dark horn brown, lower mandible pale fleshy."

There is some variation in a series of eleven specimens; in one the band across the breast is deep buff, with almost obsolete darker edges to the feathers; in several examples the under tail-coverts are dull white; some have the top of the head and back of the same shade of brown. In an immature specimen the middle and greater wing-coverts and feathers behind the eye have cinnamon spots, narrowly edged with black; the tertiaries are tipped with pale cinnamon; the throat is white, with the feathers indistinctly edged with dusky.

This species appears to be most nearly related to *R. pectoralis*, from the Malay Peninsula and Sumatra, but differs from it in having no whitish spots on the lores; the under wing-coverts, axillars, and under tail-coverts are not white; the white on the under surface is not so pure, and the upper parts are of a somewhat different shade of brown.

The genus *Rhinomyias* has not previously been recorded from the Nicobars.

"Common in Great and Little Nicobar. Keeps close to the ground, on low bushes in heavy forest. Has a rather sweet song."

HYPOTHYMIS AZUREA (Boddaert).

Muscicapa azurea BODDAERT, Tabl. Pl. Enl., 1783, p. 41 ("Philippines").

Fifteen specimens, from Nankauri, Trinkut, Tillanchong, Kamorta, Great and Car Nicobar.

"Common in all the islands, frequenting dense jungle."

HYPOTHYMIS TYTLERI (Beavan).

Myiagra tytleri BEAVAN, Ibis, 1867, p. 324 (Andamans).

Three specimens, from Henry Lawrence Island, Little and South Andaman.

Family TURDIDÆ.

GEOCICHLA ALBOGULARIS Blyth.

Geocichla albugularis BLYTH, Journ. Asiat. Soc. Bengal, XVI, 1847, p. 146 (Nicobars).

Eight specimens, from Trinkut, Kamorta, and Katchal. Length, from 190.5 to 203 mm. "Iris dark brown; orbital skin olive; bill black, pale leaden beneath, at base; feet pale brownish fleshy; claws pale horn brown. Common in the central group, i. e., Trinkut, Nankauri, Kamorta, and Katchal. Frequents the darkest parts of the jungle, keeping close to the ground."

Family PLOCEIDÆ.

MUNIA SEMISTRIATA Hume.

[*Munia*] *semistriata* HUME, Stray Feathers, II, 1874, p. 257 (Kamorta, Nicobars).

Seven specimens, representing Kamorta, Trinkut, Tillanchong, and Car Nicobar.

“Common in the islands with open grass lands. Not met with on the southern islands, which are covered with dense forest. Goes about in small flocks of six to ten.”

Family MOTACILLIDÆ.

BUDYTES FLAVA (Linnæus.)

[*Motacilla*] *flava* LINNÆUS, Syst. Nat., 10th ed., Pt. 1, 1758, p. 185 (Europe).

Three specimens, all from Trinkut.

“Common on Trinkut and Kamorta, frequenting the open grass lands and the shore.”

ANTHUS, species.

“Kloss shot one on Kamorta.” No specimens were sent. Hume records *Anthus cervinus* from this island.

Family NECTARINIDÆ.

ÆTHOPYGA NICOBARICA Hume.

Æthopyga nicobarica HUME, Stray Feathers, I, 1873, p. 412 (Kondul and Meroe, south Nicobars.)

“Only met with on Great and Little Nicobar. It was commonest at Pulo Kunyi and other places on the west coast of Great Nicobar.” It appears to be confined to the southern islands of the group; Hume met with it only on Kondul and Meroe. The female is without a trace of red on the throat, as Oates has predicted.¹ Females have a total length (in the flesh) of 111 mm.; males are slightly larger, measuring from 116 to 122 mm. “Feet dark fleshy brown; bill dark horn brown above, pale horny brown beneath.” A series of ten skins, from Great and Little Nicobar.

ARACHNECHTHRA KLOSSI, new species.

Type.—Adult male, No. 178787, U.S.N.M.; Great Nicobar, March 9, 1901; Dr. W. L. Abbott. Upper parts (except forehead and anterior part of crown), including sides of neck, ear-coverts, and lesser wing-coverts, olive green, darker on the upper tail-coverts; wings, clove brown, most of the feathers (except those of primary coverts) edged with olive green; tail, black, the middle feathers narrowly edged

¹ Fauna Brit. India (Birds), II, 1890, p. 350.

with metallic green, the three outer pairs with white tips, the outermost with white extending along outer web for about 14 mm.; the next two pairs very narrowly tipped (about 1 mm. only). Forehead, fore part of crown and throat, metallic purple, bordered on sides (including cheeks) and chest with metallic blue; just below the blue of chest, laterally, are a few burnt umber feathers. Breast, abdomen, sides of body, and under tail-coverts, lemon yellow; flanks, pale olive green; thighs, dusky brown, yellowish on inner aspect; axillars, cadmium yellow; longest under wing-coverts, white; lesser feathers, pale yellow; feathers of outer edge of under wing-coverts dusky, with yellowish tips. Length (fresh), 114 mm.; wing, 51; tail, 33; tarsus, 15; culmen, 18.5 (bill, from gape, 23). Other males have a wing measurement of 52 to 53 mm., and a total length of 108 to 117.5 mm.

This species differs from *A. pectoralis* in being slightly larger; there is less white on the outer tail feathers, and the lower part of the throat and chest is metallic blue instead of purple. The upper surface is somewhat darker than in *A. pectoralis*. "Common on all the islands visited. Breeding in February and March; we found the nests on Katchal, Great and Little Nicobar, generally in mangroves overhanging the creeks."

Seventeen specimens from the following islands: Car Nicobar, Trinkut, Tillanchong, Great and Little Nicobar.

ARACHNECHTHRA ANDAMANICA Hume.

Arachnechthra andamanica HUME, Stray Feathers, I, 1873, p. 404 (Andamans).

"Common at South Andaman and Cinque."

Eight specimens from the above islands. Length of males (six individuals) in the flesh, 114 to 118 mm.

Family PITTIDÆ.

PITTA ABBOTTI, new species.

Type.—Adult male, No. 178566, U.S.N.M.; Great Nicobar, March 30, 1901; Dr. W. L. Abbott. Closely related to *P. cucullata*,¹ but darker above and below, with lighter blue upper tail- and wing-coverts; a dark median line on crown; white patch on primaries much smaller and confined to six feathers instead of seven. *P. abbotti* is also smaller. Length, 184 mm.; wing, 110; tail, 39; tarsus, 39.5; culmen, 22 (bill, from gape 27). Other males have a wing measurement of from 103 to 105 mm.

"Iris dark brown; bill black, gape pale orange; feet pale brownish fleshy." Hume² saw several Pittas on Great Nicobar, which he

¹For permission to examine two Malacca specimens of *P. cucullata* in the Elliot collection I am indebted to the authorities of the American Museum of Natural History.

²Stray Feathers, II, 1874, p. 220.

thought to be *P. moluccensis*. Dr. Abbott has now obtained seven specimens, two of which were caught in traps set for small mammals.

“Common in Great and Little Nicobar. Like most Pittas it is rather difficult to obtain. I caught two in rat traps. Am not sure it is identical with the typical *P. cucullata*.”

Family PICIDÆ.

DRYOBATES ANDAMANENSIS (Blyth).

Picus andamanensis BLYTH, Journ. Asiat. Soc. Bengal, XXIX, 1859, p. 412, note (Port Blair, South Andaman).

One adult female, from Bumila Creek, Little Andaman.

“Upper mandible dark horn brown, lower mandible leaden. Also seen at Lawrence Island and South Andaman.”

Length in the flesh, 190.5 mm.

THRIPONAX HODGEI (Blyth).

M[ulleripicus] hodgei BLYTH, Journ. Asiat. Soc. Bengal, XXIX, 1860, p. 105 (Port Blair, South Andaman).

A pair from Henry Lawrence Island.

“Heard at South Andaman. Iris yellow.”

Length of male, 400 mm.; of female, 384 mm.

Family CORACIIDÆ.

EURYSTOMUS ORIENTALIS (Linnæus).

[*Coracias*] *orientalis* LINNÆUS, Syst. Nat., 12th ed., I, 1766, p. 159 (India orientali).

One female from South Andaman. Length, 301.5 mm.

“Iris dark brown. No others were seen.”

Family MEROPIDÆ.

MEROPS PHILIPPINUS Linnæus.

[*Merops*] *philippinus* LINNÆUS, Syst. Nat., 12th ed., Pt. I, 1766, p. 183, [errata] (Philippines).

“Common in the open lands and scrub jungle on Kamorta.” Three males were obtained on this island.

A bird identified by Dr. Abbott as a species of *Merops* was shot but lost on South Andaman.

Family ALCEDINIDÆ.

ALCEDO ISPIDA BENGALENSIS (Gmelin).

[*Alcedo*] *bengalensis* GMELIN, Syst. Nat., I, 1788, p. 450 (Bengal).

“Met with on all the islands [Nicobars] except Car Nicobar, and generally common among the mangroves.”

Four specimens, are included in the collection, from Tillanchong, Great and Little Nicobar. The differences mentioned by Hume¹ are not very plainly shown in this series.

CEYX TRIDACTYLA (Pallas).

Alcedo tridactyla PALLAS, Spic. Zool., Pt. 6, 1769, p. 10, pl. 11, fig. 1.

"Common in Great and Little Nicobar, not met with elsewhere. Frequents the heavy forest, often at a distance from water, but is commonest along small streams."

Ten examples, all from Great Nicobar. In color they resemble birds from the Mergui Archipelago, but are of somewhat greater dimensions (wing from 57 to 62 mm.).

PELARGOPSIS INTERMEDIA Hume.

[*Pelargopsis*] *intermedius* HUME, Stray Feathers, II, 1874, p. 166 (Kondul, Nicobars).

"Common among the mangroves and along the seashore in Great and Little Nicobar. Do not think it is found in the other islands, as we searched carefully for it and did not meet with it, although it is a very conspicuous and noisy bird."

Five specimens, all females, from the two islands above mentioned. "Iris, dark brown; eyelids and feet red."

The total length, in fresh birds, varies from 362 to 387 mm.

HALCYON SATURATION Hume.

[*Halcyon*] *saturation* HUME, Stray Feathers, II, 1874, p. 168. (Port Blair, South Andaman).

Four specimens, all from South Andaman, where it is reported to be "common." In two of the specimens the stomachs were found to contain the remains of small fish.

"Bill red, blackish at base above; eyelids, red; iris, brown; toes, red, front of tarsi and top of toes blackish."

Individuals vary in length from 292 to 305 mm.

HALCYON PILEATUS (Boddaert).

Alcedo pileata BODDAERT, Tabl. Pl. Enl., 1783, p. 41 (China).

"Met with on all of the islands [Nicobars], but apparently not very common, except in Great Nicobar, where it was numerous along the Galathea River."

A single individual was reported as seen on Barren Island, Andamans.

Two specimens were preserved.

¹Stray Feathers, II, 1874, p. 173.

HALCYON DAVISONI Sharpe.

Halcyon davisoni SHARPE, Cat. Birds Brit. Mus., XVII, 1892, p. 282 (Andamans).

“Common at South Andaman and Lawrence Island.”

Six specimens, from Cinque Islands and South Andaman.

The females have no buff on the under parts; an immature male, however, has a buffy wash on the flanks.

Two of the specimens had in their stomachs the remains of small fish and crabs.

HALCYON OCCIPITALIS (Blyth).

Todiramphus occipitalis BLYTH, Journ. Asiat. Soc. Bengal, XV, 1846, p. 23, note (Nicobars).

“Found in all the islands visited, commonest in the northern and central groups, less plentiful in Great and Little Nicobar. It frequents forest, clearings, and cocoanuts indiscriminately, and often found far from water.”

Eighteen examples from various islands of the Nicobar group. All of the females (seven skins) in this series are white below, having a small patch of buff on the flanks only.

The total length, as noted on the labels, varies from 241 to 273 mm. “Iris brown; upper mandible black, lower white; feet greenish mauve, claws black” (female).

Family MICROPODIDÆ.

“Swift. A large flock of swifts seen on Barren Island.”

Genus SALANGANA Isid. Geoffroy St.-Hilaire.

Salangana GEOFFR. ST.-HILAIRE, L'Écho du Monde Savant, III, 1837, p. 74.

Type, *Hirundo esculenta* Linnaeus.

Collocalia G. R. GRAY, List Genera of Birds, 1840, p. 8.

Type, *Hirundo esculenta* Linnaeus.

SALANGANA INEXPECTATA Hume.

[*Collocalia*] *inexpectata* HUME, Stray Feathers, I, 1873, p. 296 (Button Island, Andamans).

“Shot at Kamorta, seen occasionally on the other islands.” Three specimens are in the collection, all from Kamorta. “Iris brown; feet brownish pink, claws black.” Length, 120.5 mm.

SALANGANA LINCHI (Horsfield and Moore).

Collocalia linchi HORSFIELD and MOORE, Cat. Birds Mus. East India Co., I, 1854, p. 100.

Six examples, all females, from Little Nicobar.

“Met with on all of the islands [Nicobars]. On Little Nicobar, near the anchorage and water hole back of Pulo Milu, are some small

caves close to the seashore. These are inhabited by vast numbers of bats and a large colony of this swift. The largest cave was 60 feet long by 5 feet broad and 7 to 10 high. The floor was deeply covered with guano. The nests were at the farther end, thickly clustered upon the roof and upper parts of the walls. The nests were often so close to one another that the edges were adherent—three or four nests being stuck together in one mass.”

Family CUCULIDÆ.

? *SURNICULUS LUGUBRIS* (Horsfield).

Cuculus lugubris HORSFIELD, Trans. Linn. Soc. Lond., XIII, Pt. 1, May, 1821, p. 179 (Java).

“A bird apparently of this species was shot in Katchal, but lost in the dense jungle.”

? *EUDYNAMIS HONORATA* (Linnæus).

[*Cuculus*] *honoratus* LINNÆUS, Syst. Nat., 12th ed., Pt. 1, 1766, p. 169 (Malabar).

Six specimens, from Car Nicobar and Barren Island. At the last-named locality it is “very common and feeds on fruit.” In three females the wings vary from 198 to 208 mm.; in the same number of males from 198 to 209.5 mm.

The males have a greenish gloss and the females are dark colored.

? *EUDYNAMIS HONORATA MALAYANA* Cabanis and Heine.

E[udynamis] malayana CABANIS and HEINE, Mus. Hein., IV, Pt. 1, 1862, p. 52 (Sunda Islands and Sumatra).

Five specimens, from Great and Little Nicobar.

“Common in all islands visited [both forms included]. Most probably lay their eggs in grackles (*Eulabes*) holes, as it was a very common sight to see a female koel pursued by a grackle, both in a greatly excited state, shrieking and screaming with rage. They are generally detested by other birds. I think they also lay in nests of *Carpophaga*, as one could often call them up by imitating the deep hoarse coo of the fruit pigeon.”

Two males from this series have wing measurements of 220.5 and 227.5 mm.; they are large and bluish compared with specimens from Barren Island and Car Nicobar, and the females are pale-colored. One male from Little Nicobar is greenish in color, as in the individuals referred above to *E. honorata*; it has a wing only 198 mm. in length.

There appear to be two forms represented in the Andamans and Nicobars, but our material is far too meager to allow of a satisfactory disposition of the case, and I keep the birds apart here to direct attention to the matter.

Family PSITTACIDÆ.

PALÆORNIS MAGNIROSTRIS Ball.

P[alæornis] magnirostris BALL, Journ. Asiat. Soc. Bengal, XLI, Pt. 2, 1872, p. 278 (Andamans).

“Common at Lawrence Island and South Andaman. Heard at Little Andaman.” At the first-named locality it was numerous, “flying about in flocks of three or four to a dozen.”

Five specimens. “Iris pale lemon; bill red, tips of mandibles yellow; feet yellow to orange; eyelids orange.” Length of males varies from 501.5 to 571.5 mm.; a female measures 458 mm.

PALÆORNIS FASCIATUS (Müller).

Psittacus fasciatus MÜLLER, Natursyst., Suppl., 1776, p. 74 (Pondicherry).

“Common at all places visited [Andamans]. Visits the cultivated district about Port Blair in large flocks, causing great damage to the ripening paddy; large numbers are therefore killed annually.”

Several specimens, from Henry Lawrence Island, and South Andaman.

PALÆORNIS CANICEPS Blyth.

P[alæornis] caniceps BLYTH, Journ. Asiat. Soc. Bengal, XV, 1846, p. 23, note (Nicobars).

“Common on Great and Little Nicobar. It goes about in smaller flocks than the smaller species, generally keeping higher up in the trees, and is harder to get. Usually there are only two or three together. They are very noisy.”

Ten specimens, varying in length from 540 to 604 mm. in males, and 444.5 to 533.5 mm. in females.

“Iris orange red; cere and lower mandible black; upper mandible red; tip horny yellow; feet dull greenish leaden.”

PALÆORNIS NICOBARICA Gould.

Palæornis nicobaricus GOULD, Birds of Asia, VI, 1857, pl. vi (Nicobars).

“This parrot was common upon all the islands [Nicobars], generally in flocks, sometimes of twenty or thirty individuals. Very fond of fruit of the casuarina. Native name, *Talleh*.”

Twenty-six specimens, from Great, Little, and Car Nicobar, Katchal, Trinkut, and Tillanchong. The males in this series vary from 431.5 to 489 mm.; the females from 368 to 450.5 mm.

The iris is said to have an inner green circle and an outer yellow one; in some specimens it is noted as greenish white, yellowish white, or pale yellow.

PALÆORNIS TYTLERI Hume.

P[alæornis] tytleri HUME, Stray Feathers, II, 1874, p. 454 (Andamans).

"Common on Lawrence Island and South Andaman."

Three specimens from the above islands. Two females measured 309.5 and 343 mm. in the flesh; a male, 406.5 mm.

"Iris: Inner circle green, outer circle yellow; feet green; cere green; upper mandible red, lower black."

LORICULUS VERNALIS (Sparman).

Psittacus vernalis SPARRMAN, Mus. Carls., Pt. 2, 1787, No. XXIX.

"None shot. Seen and heard everywhere in the Nicobors."

Family BUBONIDÆ.

NINOX SCUTULATA (Raffles).

Strix scutulata RAFFLES, Trans. Linn. Soc. Lond., XIII, Pt. 2, 1822, p. 280 (Sumatra).

Three specimens.

A male from Car Nicobar measures 279.5 mm. It has a wing 206 mm. in length. Hume records a male from the same island with a wing measurement of 213.5 mm., and a total length of 286 mm.

From Katchal we have a female measuring 286 mm., with a wing barely 203 mm. Both of the above birds resemble in color those of India.

A male from Little Nicobar is not only smaller, but differs very much in color from the others. There is a fulvous suffusion of the lower surface, the white bars of the sides and abdomen and the white streaks on the breast being almost entirely obscured. The under tail-coverts are white, spotted, and barred with brown. In total length this specimen measures 273 mm.; the other dimensions are: Wing, 198; tail, 118; tarsus, 30; culmen, 20 mm. In this individual the iris was deep yellow; feet pale yellow.

The stomachs of two of the specimens contained beetles.

Family FALCONIDÆ.

SPILORNIS KLOSSI, new species.

Type.—Adult male, No. 178429, U.S.N.M.; Pulo Kunyi, Great Nicobar, March 20, 1901; Dr. W. L. Abbott. General color above, including greater wing-coverts, secondaries, and tertiaries, drab,¹ with a slight coppery sheen in certain lights, some of the feathers (especially of the secondaries, tertiaries, and greater wing-coverts) with narrow white tips; nape and sides of neck Isabella color;² top of head,

¹Ridgway's Nomenclature of Colors, pl. III.

²Idem, pl. III.

including long occipital feathers, black, the longer feathers with narrow tips of Isabella color; ear-coverts, cheeks, and malar region clear smoke gray;¹ throat buffy white, with an indistinct median stripe of smoke gray; breast buffy wood brown, becoming much paler on the abdomen, sides, thighs, and under tail-coverts; lesser and middle wing-coverts dark drab, prominently edged with white; axillaries and under wing-coverts like the abdomen, the outer portion of the under wing-coverts pale buffy white. Primaries black at the ends, some of the inner ones with narrow white tips; base of the wings (from below) white, the feathers with two dusky bars (only one bar on the outermost primaries). Tail light drab, with a broad black subterminal band, and a second narrower one near the middle, less distinct on the two inner pairs of feathers. Wing, 257 mm.; tail, 165; tarsus, 75; culmen, 33. "Length, 431.5. Iris yellow; cere, base of bill, and naked skin on side of head, yellow. Bill, tip black, middle bluish." This is a very distinct species, and one of the smallest of the genus. It is easily recognized by its unspotted underparts, gray patch on side of head, and very small size. Ten of the eleven specimens sent by Dr. Abbott are adult, and show the characters given in the above description. Some of them are a little darker below than the type, and in several the throat is more or less gray. In one female, doubtless a very old bird, the underparts are considerably darker than in the type, and the lower breast and sides are faintly spotted with buff; the lower sides and thighs are also narrowly barred with buffy wood brown.

The immature bird differs from the adults in having buffy tips to the feathers of the back, wing-coverts, top of head, and to the upper tail-coverts; the wing feathers are tipped with white, the tail is less prominently barred, and has three narrow bars instead of two. In this specimen the iris was "brownish gray; feet, dirty yellow; cere and orbital skin, yellow, with a greenish tinge."

The males measure (in the flesh) 419 to 431.5 mm.; two females are 457 mm. The stomachs of those shot contained the remains of lizards, rats, a small bird, and a pigeon (*Chalcophaps indica*).

This species is named in honor of Mr. C. Boden Kloss, who accompanied Dr. Abbott on his Nicobar and Andaman trip, and prepared many of the specimens of the present collection. *S. klossi* was found only on Great Nicobar, where it was common and quite tame.

SPILORNIS MINIMUS Hume.

Spilornis minimus HUME, Stray Feathers, I, 1873, p. 464 (Kamorta, Nicobars).

"One wounded but lost upon Trinkut, a pair shot on Kamorta, and half a dozen shot on Katchal, where they were common. On Little Nicobar we failed to secure any, although we saw several."

¹Ridgway, pl. II, No. 12.

The stomachs of three specimens contained the remains of lizards, another had portions of a fowl, and one a small crab. The males measure (in the flesh) 447.5 to 463.5 mm.; the females 457 and 470 mm. The Kamorta specimens are: Male, 470 mm.; female, 482.5 mm. The wings of the females measure 288 to 292 mm.; the males, 256.5 to 284.5 mm.

Most of the specimens were shot in dense jungle.

SPILOORNIS, species.

“Heard on South Andaman. None shot.”

HALIÆETUS LEUCOGASTER (Gmelin).

[*Falco*] *leucogaster* GMELIN, Syst. Nat., I, Pt. 1, 1788, p. 257.

“Common along the sea-coast everywhere [Nicobars].” No specimens were preserved.

ASTUR BUTLERI Gurney.

Astur butleri GURNEY, Bull. Brit. Orn. Club, VII, 1898, p. xxvii (Car Nicobar).

Adult male. Length, 286 mm. “Iris orange yellow; feet yellow, claws black. Bill leaden, cere greenish. Stomach contained lizards.”

Adult female. Length, 317.5 mm. “Iris orange yellow; cere black, bill black, leaden beneath at base; feet yellow, claws black. Shot in heavy forest, where it appears to be common.” This species was found only on Car Nicobar, “where it appeared to be pretty common in a patch of heavy forest; not met with in the open ground or in the scrub jungle. The place was a long way from the anchorage, and we only visited it twice.” The male is very indistinctly barred below, and the middle and outermost pairs of tail feathers are entirely unbarred; the three pairs of rectrices next to the central ones have three bars. The female is much more prominently marked below, and the middle pair of rectrices has a subterminal black bar; the next three pairs have four bars.

ASTUR OBSOLETUS, new species.

Type.—Adult female, No. 178448, U. S. N. M.; Katchal Island, Nicobars, February 18, 1901; Dr. W. L. Abbott. General color of upper parts (including middle and greater wing-coverts, secondaries, and upper tail-coverts) gray¹, paler² on crown, nape, sides of neck, cheeks, and ear-coverts; lesser wing-coverts slate gray, becoming darker (slate color) on primary coverts and primaries, the latter being black on the inner webs at the tips. Lores, an ill-defined stripe over the eyes, throat, malar apex, thighs, abdomen, under wing- and tail-coverts, and axillaries white; breast and sides white, with obsolete bars of pale fawn color. Tail gray, narrowly tipped with white, the middle and outer pairs of feathers without bands, the others with five

¹Ridgway's Nomenclature of Colors, pl. 11, No. 8.

²Idem, No. 10.

indistinct bars, more prominent on the inner webs. Inner webs of primaries and secondaries (except at tips) white, obscurely mottled with dusky. Wing, 192 mm.; tail, 157 mm.; tarsus, 52 mm.; culmen, 21.5 mm.; length, 330 mm. "Iris dark crimson; feet yellow; bill blackish at tip, horn blue at base; cere greenish; eyelids greenish. Stomach contained lizards." A second female measured 343 mm. "Iris crimson!! Stomach contained insects. Shot in dense jungle." A third individual, also a female, has a total length of 343 mm. "Iris red. Stomach contained lizards." This specimen has traces of immaturity in some black-tipped ferruginous feathers on sides of neck and on the scapulars.

This interesting hawk closely resembles *A. butleri* above, but is paler on the nape and sides of head; it differs also in the indistinct white superciliary line and white lores and throat. Below it resembles *A. butleri* in pattern, but with the reddish color on breast almost entirely absent. In *A. obsoletus* the irides are crimson; in *A. butleri* and allies they are orange or yellow.

Dr. Abbott saw five or six others on Katchal, but did not obtain them. "The bird called up easily, but generally lit so close to one that it was not desirable to shoot, and at the slightest movement they were off, and all were in dense jungle. In Kamorta I saw a small hawk which seemed like *A. butleri*, but failed to secure it."

This Kamorta hawk will doubtless prove to be *A. obsoletus*.

ASTUR SOLOENSIS (Horsfield).

Falco soloënsis HORSFIELD, Trans. Linn. Soc. Lond., XIII, Pt. 1, May, 1821, p. 137 (Java).

Twelve specimens, from Katchal, Great and Little Nicobar. The total length, in fresh birds, is noted as 273 to 298.5 mm. The iris is stated to be "brown" or "dark brown" in the males, and "lemon yellow" to "orange" in the females; those in an immature male were "brownish orange."

The individuals of this series vary greatly in the amount of ferruginous on the breast, but several of them are identical with a specimen from Korea.

"A small hawk, which may be this species, was first obtained in Katchal in dense forest. We afterwards found it common in Great and Little Nicobar. They 'called up' easily."

Von Pelzeln records a hawk under this name from Car Nicobar, which may possibly have been *A. butleri*.

FALCO PEREGRINUS Tunstall.

[*Falco*] *peregrinus* TUNSTALL, Oph. Britannica, 1771, p. 1 (Great Britain).

One adult male, from Kamorta.

"Shot near a small jheel, where it had just made a dash at a flock of teal [*Dendrocygna javanica*]. Iris dark brown." Length, 416 mm.

Family TRERONIDÆ.

OSMOTRERON CHLOROPTERA (Blyth).

Tr[eron] chloroptera BLYTH, Journ. Asiat. Soc. Bengal, XIV, Pt. 2, 1845 (1846), p. 852 (Nicobars).

“Common on all of the islands visited.”

There are eight specimens in the collection, from Trinkut, Nankauri, Tillanchong, Little and Great Nicobar.

Length varies from 317.5 to 333 mm. in males, and 305 to 324 mm. in females. “Feet dull purple; bill pale leaden, greenish at base and on cere; iris, inner circle blue, outer one pink.”

OSMOTRERON CHLOROPTERA ANDAMANICA, new subspecies.

Type.—Adult female, No. 178813, U.S.N.M.; Macpherson Strait, South Andaman, January 15, 1901; Dr. W. L. Abbott. Similar to *O. chloroptera* (Blyth), from the Nicobars, but rather smaller, colors somewhat darker above and below; breast and sides deeper yellowish green, and under tail-coverts more yellowish; the throat is yellower than in *O. chloroptera*. Wing, 165 mm.; tail, 91; tarsus, 26; culmen, 20. Length, 292 mm. “Bill leaden, cere and base of bill greenish.”

Another female measures: Wing, 168 mm.; tail, 98; tarsus, 26.5; culmen, 20. Length, 317.5 mm.

Three females of *O. chloroptera* measure:

Wing.	Tail.	Tarsus.	Culmen.
<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
175	99	28	20
171	98	25	18
170.5	98	24.5	20

The new form is “common at South Andaman.”

CARPOPHAGA ÆNEA (Linnæus).

[*Columba*] *ænea* LINNÆUS, Syst. Nat., 12th ed., Pt. 1, 1766, p. 283 (Moluccas).

One specimen, an adult male, from Rutland Island, Andamans. “Observed at South Andaman, Cinque, and Little Andaman. A number seen at Barren Island. Iris crimson.” Length, 431.5 mm.

CARPOPHAGA INSULARIS Blyth.

C[arpophaga] insularis BLYTH, Journ. Asiat. Soc. Bengal, XXVII, 1858, p. 270 (Nicobars); a *nomen nudum* here.

“Common on all these islands [Nicobars]. On Tillanchong and Trinkut they were remarkably tame; we easily shot them with the .32-cal. auxiliary barrels. They, with the megapodes, formed our staple diet in the Nicobars until we loathed the sight of them. The iris is crimson.”

Males vary in length from 425.5 to 470 mm.; females measure 431.5 to 457 mm. The weight of a male is noted as 1½ pounds. Thirty-four specimens were collected.

Blyth's name *insularis* as usually quoted is a *nomen nudum*, but I am at present unable to give a more satisfactory reference. Von Pelzeln's term *nicobarica*¹ may have to be used for this species, but for the present I prefer to retain *insularis*, as Blyth had a very careless way of instituting new names and it is not improbable that an earlier reference will be found. He was aware of a Nicobar form as early as 1849.²

MYRISTICIVORA BICOLOR (Scopoli).

Columba (bicolor) SCOPOLI, Del. Flor. Fann. Insub., II, 1786, p. 94 ("nova Guiana").

One specimen each from Kamorta, Trinkut, Little and Car Nicobar.

"Less common than the last in the northern islands, but very plentiful in the southern. At Little Nicobar large numbers used to roost on the islets of Trak and Treis, six or seven miles distant, and fly over every morning to Little Nicobar."

Also reported as seen at Barren Island, in the Andamans.

CALÆNAS NICOBARICA (Linnæus).

[*Columba*] *nicobarica* LINNÆUS, Syst. Nat., 10th ed., Pt. 1, 1758, p. 164 (Nicobars).

"Met with on all the islands [Nicobar group], but by far most plentiful upon Great Nicobar."

Nine specimens, from Katchal, Great and Little Nicobar. The females range from 355.5 to 368.5 mm. in total length; the males, 381 mm.

CHALCOPHAPS INDICA (Linnæus).

[*Columba*] *indica* LINNÆUS, Syst. Nat., 10th ed., Pt. 1, 1758, p. 164 (India orientali).

"Not seen on Car Nicobar, but common elsewhere."

Four specimens from Tillanchong, Katchal, Trinkut, and Great Nicobar. These measure, in the flesh, from 260 to 273 mm.

ALSOCOMUS PALUMBOIDES (Hume).

Carpophaga palumboides HUME, Stray Feathers, I, 1873, p. 302 (Port Mouat, South Andaman).

No specimens were obtained, but Mr. Kloss had a shot at one in the Nicobars.

MACROPYGIA RUFIPENNIS Blyth.

Macropygia rufipennis BLYTH, Journ. Asiat. Soc. Bengal, XV, 1846, p. 371 (Southern Nicobars).

"Not met with at Car Nicobar, but found on all the other islands. Most common on Katchal, where all those we shot had been feeding

¹Novara exped., Vögel, 1865, p. 105. ²See Cat. Birds Mus. Asiat. Soc., p. 231.

upon chillies (small red peppers) that had escaped from cultivation. Did not see many on Great Nicobar. Those in Katchal were mostly about the open ground and in the cocoanuts. The iris is composed of two rings, the inner one white or blue, the outer one crimson; the orbital skin is blue; feet dull red; bill dark horn brown, cere paler."

Eight specimens, from Kamorta, Katchal, Tillanchong, and Great Nicobar.

Males have a total length of 394 to 425.5 mm.; females, 390.5 mm.

Family PHASIANIDÆ.

EXCALFACTORIA TRINKUTENSIS, new species.

Type.—Adult female, No. 178575, U.S.N.M.; Trinkut Island, Nicobars, February 4, 1901; Dr. W. L. Abbott. Similar to the female of *E. chinensis*, but general coloration darker and richer; ground color of feathers of the back, scapulars, and sides of neck grayish, instead of brown; forehead, a broad superciliary band, cheeks and throat, fawn color,¹ paler on chin; entire underparts, except throat, barred. In the female of *E. chinensis* the abdomen is buffy white, unmarked; with this exception the pattern of coloration in the two forms is the same. Wing, 65 mm., tail, 22, tarsus, 24.5, culmen, 10. Length, 133.5. "Feet yellow."

One specimen only was collected, although reported as "common in the open grass lands of Trinkut and Kamorta."

Family MEGAPODIDÆ.

MEGAPODIUS NICOBARIENSIS Blyth.

Megapodius nicobariensis BLYTH, Journ. Asiat. Soc. Bengal, XV, 1846, p. 52 (Nicobars).

"Common in all the islands except Car Nicobar; whether it exists here we could not find out. We did not see any, but Solomans, the Madrassé catechist, said he had seen some in the heavy forest north of Kemios, and near the middle of the island. The natives gave contradictory accounts. We first met with them at Tillanchong, where at first we thought they were scarce, but they proved to be very common. Many of their nest mounds were on a sandy strip by the sea shore. The largest mound was 30 feet in diameter and 8 feet high, composed almost entirely of sand, with very few dead leaves. The temperature in the interior is much raised and feels hot to the hand, when one is engaged in digging out the eggs. This was an exceptionally large mound, and, having seen hundreds of mounds since that, should say the average diameter is 10 to 15 feet and 4 feet high.

The megapodes are not exactly shy, but they are difficult to shoot,

¹ Ridgway's Nomenclature of Colors, pl. III, no. 22.

in most places, as the jungle is so dense. Afterwards, in the dense forest in Katchal and in Great and Little Nicobar where the jungle is more open, we easily obtained all we wanted.

At first we thought Megapodes delicious eating, but we soon got tired of them. Their excrement is very foul, owing to their animal (insect and land shell) diet. The eggs are excellent when fresh.

A writer in the Government Gazette (of Port Blair) speaks of the impending extermination of the Megapodes from the practice of the natives robbing the nest mounds. There is not the slightest danger of this. Many of the mounds are in impenetrable jungles. The natives are but few and dying out rapidly in the southern and middle groups. The coast people are well-nigh extinct in Great and Little Nicobar. Even where the mounds are visited, all the eggs are not found, and the mounds exist in hundreds. Even on Pilu Milu, a very small island off Little Nicobar, there are plenty of Megapodes and mounds, and the island is and has always been inhabited."

Twenty-five specimens, from various islands, show little variation. In total length, males vary from 381 to 400 mm.; females from 374.5 to 409.5 mm. Females weighed 30 ounces to 2½ pounds (the latter being the one 409.5 mm. in length).

The fresh colors are noted as follows: "Eyelids red; sides of head vermilion; skin of throat pale mauve pink; iris clear brown; bill greenish horn; legs dull reddish, brown in front; soles dull ochraceous, claws black."

A female obtained on Tillanchong was "shot while digging a hole for its egg in the nest mound. The mound was situated just within the edge of the jungle by the seashore, and had several small coconut trees growing upon it. The dimensions of the mound were 8 feet high and 30 feet in diameter. It was composed almost entirely of sand, few leaves apparently. This bird's mate was shot a few moments previously on top of the same mound." The native name of the Megapode is "Kongáh."

In addition to a good series of the birds, Dr. Abbott sent over 30 eggs.

Family TURNICIDÆ.

TURNIX ALBIVENTRIS Hume.

[*urnix*] *albiventris* HUME, Stray Feathers, I, 1873, p. 310 (Port Mout, South Andaman).

"Common in Kamorta, in the open grass."

One adult male, from the above island. "Feet pale yellow brown; bill dark horn brown, yellow at base beneath." Length, 158.5 mm.

Family RALLIDÆ.

HYPOTÆNIDIA OBSCURIOR Hume.

[*Hypotœnidia obscuriora* HUME, Stray Feathers, II, 1874, p. 302 (Andamans).

Two were "seen, and one shot on a patch of coarse grass by the seashore on South Andaman. One was seen on Little Andaman." Length of an adult female, 266.5 mm.

A dark-colored rail was seen on Kamorta, in the Nicobar group, and thought by Dr. Abbott to be of this or a closely related species.

AMAURORNIS INSULARIS Sharpe.

Amaurornis insularis SHARPE, Cat. Birds Brit. Mus., XXIII, 1894, p. 162 (Andamans and Nicobars).

An adult male, "shot at the hot spring" in Barren Island, measures 326.5 mm. "Iris umber; bill pale green, base of upper mandible orange brown."

In the Nicobars it is reported to be "common on all the islands, in dry jungle as well as in swampy ground."

Specimens were sent from Great Nicobar, Trinkut, Katchal, and Tillanchong. An adult from the last-named island measures 343 mm. "Iris reddish brown; feet yellow; bill greenish yellow, part between the eyes and nostrils orange-vermilion."

Family CEDICNEMIDÆ.

ORTHORHAMPHUS MAGNIROSTRIS (Vieillot).

Edicnemus magnirostris VIEILLOT, Nouv. Dict. d'Hist. Nat., XXIII, 1818, p. 231.

"A single pair seen at North Cinque."

One female, from the above island. This measures 520.5 mm. "Iris yellow; feet pale yellowish, claws dark horn brown."

Family DROMADIDÆ.

DROMAS ARDEOLA Paykull.

Dromas ardeola PAYKULL, K. Vet.-Akad. Handl., XXVI, 1805, p. 188, pl. viii (East Indies?).

No specimens collected. "Two were seen in Katchal, and twice large flocks were seen in Great Nicobar."

Family SCOLOPACIDÆ.

NUMENIUS ARQUATUS (Linnæus).

[*Scolopax arquata* LINNÆUS, Syst. Nat., 10th ed., Pt. 1, 1758, p. 145 (Europe).

No specimens preserved. Noted as "seen in Katchal and Great Nicobar."

NUMENIUS PHÆOPUS (Linnæus).

[*Scolopax*] *phæopus* LINNÆUS, Syst. Nat., 10th ed., Pt. 1, 1758, p. 146 (Europe).

Five skins; three from Nankauri and two from Kamorta. The length, in fresh birds, ranges from 438 to 444.5 mm.

“Common among the mangroves in all of the islands; many seen at West Bay, Katchal.”

It was also observed at South Andaman.

ACTITIS HYPOLEUCOS (Linnæus).

[*Tringa*] *hypoleucos* LINNÆUS, Syst. Nat., 10th ed., Pt. 1, 1758, p. 149 (Europe).

One male, collected at MacPherson strait, South Andaman. It is reported as “common along the seashore” in both the Andamans and Nicobars.

TOTANUS TOTANUS EURHINUS Oberholser.

Totanus totanus eurhinus OBERHOLSER, Proc. U. S. Nat. Mus., XXII, 1900, p. 207 (Lake Tsomoriri, Ladak).

Two males, from Kamorta and Car Nicobar. Total length, 263.5 and 279.5 mm.

“Generally distributed.”

GALLINAGO, species.

“We several times flushed snipe on Trinkut—none shot.”

Family **ARDEIDÆ.**

? **ARDEA MANILLENSIS** (Meyen).

Ardea purpurea var. *manillensis* MEYEN, Acta Acad. Leop.-Carol., XVI, suppl., p. 102.

“A smaller heron [than *A. sumatrana*] with a rufous neck was several times seen on Great Nicobar.”

ARDEA SUMATRANA Raffles.

Ardea sumatrana RAFFLES, Trans. Linn. Soc. Lond., XIII, Pt. 2, 1822, p. 325 (Sumatra).

None obtained.

“One flushed in a jheel in Trinkut; also seen in Katchal and Great Nicobar.”

BUBULCUS COROMANDUS (Boddaert).

Canceroma coromanda BODDAERT, Tabl. Pl. Enl., 1783, p. 54 (Coromandel).

An adult from Tillanchong.

DEMIGRETTA SACRA (Gmelin).

[*Ardea*] *sacra* GMELIN, Syst. Nat., I, Pt. 2, 1788, p. 640 (Tahiti).

“Seen at South Andaman,” but no specimens were obtained. On the Nicobars it was “generally to be seen along the seashore.”

BUTORIDES SPODIOGASTER Sharpe.

Butorides spodiogaster SHARPE, Bull. Brit. Orn. Club, III, 1894, p. xvii (Andamans and Nicobars).

"Common in the mangroves everywhere" throughout the Nicobars. An immature female was collected on Little Nicobar. This individual, which is full grown, measured 450.5 mm. in the flesh.

ARDETTA SINENSIS (Gmelin).

[*Ardea*] *sinensis* GMELIN, Syst. Nat., I, Pt. 2, 1788, p. 642 (China).

An adult female from Trinkut.

"Iris, yellow;" length, 381 mm.

ARDETTA CINNAMOMEA (Gmelin).

[*Ardea*] *cinnamomea* GMELIN, Syst. Nat., I, Pt. 2, 1788, p. 643 (China).

One adult female, obtained in Kamorta.

"Iris, yellow;" length, 387 mm.

Family ANATIDÆ.

DENDROCYGNA JAVANICA (Horsfield).

Anas javanica HORSFIELD, Trans. Linn. Soc. Lond., XIII, Pt. 1, May, 1821, p. 199 (Java).

A pair obtained in Kamorta, where they were found in a small jheel.

"Iris, dark brown; eyelids, yellow."

NOTES ON A COLLECTION OF FISHES FROM THE ISLAND OF FORMOSA.

By DAVID STARR JORDAN,

President of Leland Stanford Junior University,

and

BARTON WARREN EVERMANN,

Ichthyologist of the United States Fish Commission.

The island of Formosa is now part of the Japanese Empire. Beyond the general fact that its fauna must be similar to that of the neighboring coasts of China and the Philippines, scarcely anything is known of its fishes. In the present paper is given the record of two collections made under Japanese auspices. The first was obtained by Mr. Tsunatsuke Tada, teacher in the Middle School at Osaka, for the Imperial University of Tokyo. The second was obtained by Japanese naval officers and others for a fisheries exhibit in Tokyo, and has been deposited in the Imperial Fisheries Institute or School of Fisheries of Tokyo. The latter collection was placed in our hands by Dr. Shimosuke Matsubara, director of the Fisheries Institute. These specimens are without other locality than "Taiwan," and are apparently a series of the common market fishes of the port of Keerun (Keelung), the chief port of Formosa. This collection contains but few duplicates. The collection of Mr. Tada was made in six localities: Keerun, Taihoku, Giran, Toii, Suwata (Suwo Bay), Kotosho, and Hokoto. Taihoku is the capital of Formosa on the Tan Sin (fresh water) river. Keerun (Keelung) is its seaport at the north end of the island. Giran is a neighboring seaport to the eastward of Keerun. Toii and Suwata are near Giran. Hokoto, or Pescadores, is a large group of islands to the westward of Formosa; Kotosho a smaller group to the southeastward. Giran is about 50 miles to the westward of Ishigaki, in the Riukiu group. This collection is made up chiefly of small fishes, but among them are numerous duplicates, of which specimens have been placed in the United States National Museum and in the Museum of Stanford University.

The authors are indebted to Mr. Edmund Heller for a preliminary identification of part of the collection, a piece of work which other duties have prevented him from completing. Important aid has also been given by Mr. Michitaro Sindo.

In the following list the specimens received from the Fisheries Institute without other locality than Taiwan (Formosa) and returned to that institution are marked F. I. The specimens have mostly Japanese collectors' numbers. 1 x, 2 x, etc.; those not so provided were given numbers by us. These numbers, remaining attached to the specimens for purposes of identification, may serve as a convenience to future students in Japan. The following genera and species seem to be new to science:

Zacco, new genus.

Zacco erolans, Taihoku.

Acheilognathus mesenbrinum, Kotosho.

Anguilla remifera, Formosa (Keerun?).

Gymnothorax pescadoris, Hokoto.

Erenchelys (new genus), Kotosho.

Ophicephalus tadianus, Formosa (Tan Sin R.?).

Channa formosana, Suwata.

Bleekeria mitsukurii, Giran.

Pempheris nyctereutes, Hokoto.

Nemipterus matsubarae, Giran.

Plectrotychus ocyurus, Formosa.

Polydactylus rhadinus, Formosa.

Chacrops nyctemblema, Formosa (Keerun?).

Hemipteronotus verrens, Keerun.

Sillago xobus, Keerun.

Salarias numiyei, Hokoto.

Brotula formosa, Formosa.

Cymoglossus diplasios, Formosa (Keerun?).

Family HEMISCYLLIIDÆ.

1. CHILOSCYLLIUM INDICUM (Gmelin).

We refer our specimen to *Chiloscyllium indicum*, although the dorsal fins are somewhat farther apart than is shown in Dr. Day's figures of that species, separated by an interspace equal to the distance from the snout to base of pectorals. The snout is a little shorter than in *C. indicum*, 2.1 in head.

Description of specimen No. 1638, F. I., Formosa: Length, 685 mm.; head and body (snout to anus) 3 in length; head 2.5 in head and body; snout 5 in head and body; snout to mouth 4.5 in head and body; pectoral 3 in head and body; ventrals 4 in head and body; height first dorsal 1.4 times the base; interspace of dorsals 2.75 base of first dorsal.

Head flat above, the interorbital portion slightly concave; back with a low median ridge extending from above pectorals nearly to first dorsal, another between the dorsals, and one posterior to second dorsal.

Pectoral wide, rounded, beginning between second and third gill-slits; first dorsal slightly higher than second, truncated and beginning slightly posterior to posterior base of ventrals, separated from second dorsal by an interspace equal to length of pectoral; second dorsal similar in shape and size to first dorsal, situated considerably in advance of anal, from which it is separated by an interspace nearly equal to base of anal; anal low, rounded anteriorly and separated by a deep notch from the caudal; caudal long and low, length more than one-half head and body, truncated posteriorly and deeply notched below near the tip. Mouth wide, width equal distance of spiracle from first gill-slit; distance from tip of snout slightly less than one-half snout; inferior labial fold continuous; angle of mouth somewhat nearer eye

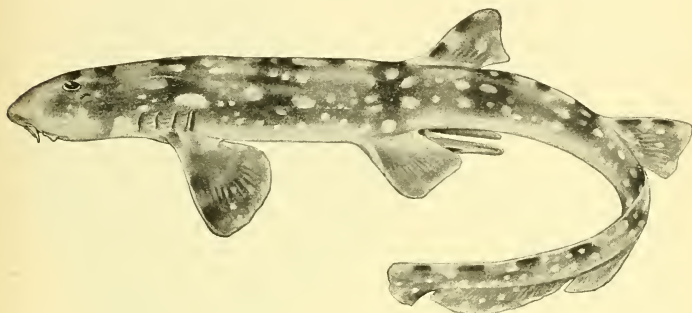


FIG. 1.—*CHILOSCYLLIUM INDICUM*.

than tip of snout; nasal tentacles slender, tapering, length equal to diameter of eye; teeth triangular, with a pair of small lateral cusps at the base of medium size.

Coloration, above grayish, marked with about 9 broad transverse bands of brownish inclosing light spots; pectorals, dorsals and caudal spotted like the back; below light grayish or yellowish-gray, unspotted.

Only one specimen in the collection which has been returned to the Fisheries Institute.

Measurements.

Length, 685 mm.	First dorsal, height, 27.
Snout to anus, 236 mm.	First dorsal, base, 20.
Head, 41 (hundredths of length to anus).	Second dorsal, height, 26.
Snout, 19.	Interspace of dorsals, 36.
Interorbital, 12.	Caudal, length, 55.
Snout to mouth, 9.	Base of anal, 25.
Pectoral, length, 35.	Second dorsal to anal, 23.
Ventral, length, 26.	

Dr. Günther records *Chiloscyllium indicum* from Formosa¹ and Nystrom records it from Nagasaki.

¹Cat. Fish., VIII, p. 412.

Family GALEORHINIDÆ.

2. TRIAKIS SCYLLIUM Müller and Henle.

Three small specimens in the collection, all unspotted: No. 6169, Formosa, F. I., 6173 (74x), Formosa, F. I., 6444 (72x), Formosa, F. I. A larger one, No. 12250, Formosa, F. I., is spotted and banded as in Japanese specimens.

3. GALEORHINUS JAPONICUS (Müller and Henle).

One rather small specimen, 570 mm. in length, No. 6168, Formosa, F. I.

4. SCOLIODON WALBEEHMI (Bleeker).

A single specimen, 525 mm. in length, differs from descriptions of this species only in the slightly shorter snout and interspace between anal and ventrals. No. 6166, Formosa, F. I.

Family SPHYRNIDÆ.

5. SPHYRNA ZYGÆNA (Linnæus).

One small specimen in the collection. No. 73x=6165, Formosa, F. I.

Family SQUALIDÆ.

6. SQUALUS, species.

Two fetuses. One of these has been compared with a fetus of *Squalus mitsukurii*, from Misaki. The Formosa specimen has the dorsal spines considerably lower and the snout shorter. It may belong to some different species. Dorsals and pectoral largely black, with white edgings in both. No. 6169, Formosa, F. I.

Family RHINOBATIDÆ.

7. RHINOBATUS SCHLEGELI Müller and Henle.

Our specimen, which is 490 mm. in length, is without tubercles on the median line of back. No. 6170, Formosa, F. I. = 70xx.

Family DASYATIDÆ.

8. DASYATIS AKAJEI (Schlegel).

Description of specimen No. 6445 = 77x, Formosa, F. I. Length of disc, 210 mm.; width $1\frac{1}{2}$ length; snout 4 times in length of disc; interorbital width twice snout; tail 2 times length of disc; disc somewhat broader than long and rounded at the pectoral angles; snout slightly produced beyond the oblique anterior edges of the disc; interorbital space with a large triangular depressed area; snout with a

shallow median groove; eyes smaller than the large spiracles; ridge of back with a series of blunt spines, the interscapular one largest; a short series of three or four spines on the scapular region running parallel to the median series; dental laminae slightly undulated; floor of mouth with three tentacles.

Cutaneous fold along inferior surface of tail distinct, height about one-half pupil, beginning below caudal spine and extending to middle of tail; a much shorter and somewhat lower fold on superior surface of tail situated a considerable distance behind the spine; base of tail armed above with a median series of five stout spines situated some

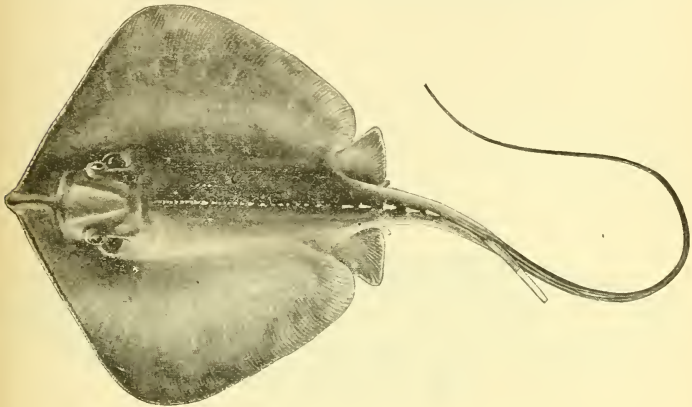


FIG. 2.—*DASYATIS AKAJEI*.

distance anterior to the caudal spine, which is placed about one-fourth distance from origin of tail; caudal spine of our specimen broken at tip, the basal portion without serrations.

Coloration above, purplish brown, becoming lighter toward edges of disc and posteriorly; tail like back; below uniform whitish.

This specimen differs a little from *Dasyatis akajei*, but is probably the young of that species.

Measurements of specimen No. 77r.

Length of disc, 210 mm.
Width of disc, 235 mm.
Tail, 420 mm.

Snout, 0.26.
Interorbital width, 0.13.
Ventrals, 0.20.

The proportional measurements are based on length of disc as the unit of comparison.

Family SILURIDÆ.

9. GLANIS ASOTUS (Linnæus).

Anal fin united to the caudal.

Head 5; depth 5.25; snout 3.3 in head; eye 3 in snout; interorbital 2.5 in head. D. 4; A. 81; P. I. 12; V. 11; C. 16. Body spindle-shaped, anteriorly depressed and posteriorly compressed; body deepest a little posterior to dorsal, from which point it slopes obliquely down to the broad depressed snout; mandible depressed like the snout, projecting; body posteriorly depressed and tapering gradually to the tail; interorbital space flat; a well-marked median dorsal groove from occiput to middle of anal.

Teeth in broad villiform bands in both jaws and in a broad continuous band on vomer; maxillary barbels long, reaching past end of ventral spine; mandibular tentacles short, equaling interorbital width; eye small, diameter 4 times in interorbital width; snout short, rounded, 3.3 in head; lateral line following outline of back, continuous from above opercle to base of caudal.

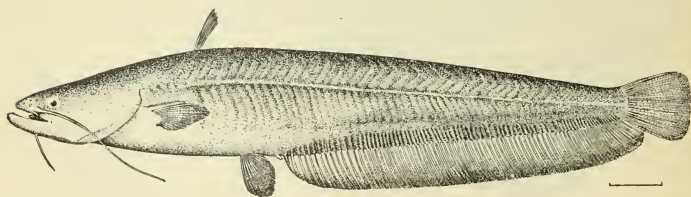


FIG. 3.—GLANIS ASOTUS.

Dorsal short, of 4 rays, placed about midway between insertion of pectorals and ventrals, height about 3 in head; pectoral inserted below angle of opercle, the longest rays reaching slightly past vertical from dorsal; pectoral spine strong, serrated on outer edge, length equal to height of dorsal; ventrals situated before anus, obtusely pointed, longest rays exceeding pectoral spine; anal long, beginning at anus and extending to the caudal to which it is united, height equal to that of dorsal; caudal 2 in head, truncate.

Coloration above, brownish-olive; fins, the same; below, yellowish-white, the mandible, sides below pectoral, and breast along gill-openings finely brown-spotted.

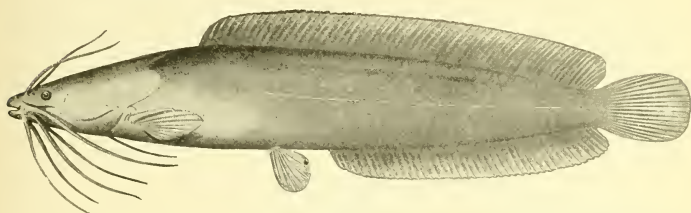
One specimen, 12 inches long, from Formosa, without indication of locality, but doubtless from the Tan Sin River at the capital, Taihoku. The generic name *Glanis* Agassiz is equivalent to *Parasilurus* Bleeker.

10. PLOTOSUS ANGUILLARIS (Bloch).

One specimen, No. 12071, from Giran.

11. *CHLARIAS FUSCUS* (Lacépède).

Two specimens, Nos. 6446, from Taihoku, and 5060 from Formosa, F. I. The first has P. I., 9; A. 43.

FIG. 1.—*CHLARIAS FUSCUS*.12. *TACHYSURUS SINENSIS* Lacépède.

One specimen, No. 6171, F. I., with the dorsal and pectoral spines somewhat shorter and the palatine patches of teeth more rounded than in the published figures, otherwise agreeing. A young example, No. 12075, Suwata, is an immature representative probably of the same species.

13. *TACHYSURUS FALCARIUS* Richardson.

One specimen, No. 6171; Suwata.

Family COBITIDÆ.

14. *MISGURNUS ANGUILLICAUDATUS* Cantor.

Two specimens, No. 5065, from Taihoku; one 57x, Formosa, F. I.

Family CYPRINIDÆ.

15. *CYPRINUS CARPIO* Linnæus.

One specimen, No. 875=53x, Formosa, F. I.

16. *CARASSIUS AURATUS* (Linnæus).

Giran; Taihoku, No. 3830, Formosa, F. I.; No. 866=57x, Formosa F. I.

17. *ROHITA DECORA* (Peters).

One specimen, No. 3837=57x, Formosa, F. I., 162 mm. long.

D. 16, its first rays unbranched; A. 9, its first rays very small, the 7 posterior rays branched; P. 19; C. 20; scales 40; pharyngeal teeth 5-4, 2; head 5.5 in length; depth 3.2; eye 3.3 in head; no maxillary barbels.

The generic name *Rohita* should take the place of *Labeo* which is

preoccupied in *Sparidae* by *Labco* Bowdich, 1825 = *Boops* Cuvier, 1817. *Labco sparoides* Bowdich, Exe. Madeira, 1825, p. 122, fig. 59, is identical with *Boops boops* (Linnaeus).

18. CTENOPHARYNGODON IDELLUS (Cuvier and Valenciennes).

One large specimen, 355 mm. long, agreeing fairly with Günther's description. Head 4.3; depth 3.3; pharyngeal teeth 2, 5-4, 2; D. 10; A. 11; V. 10; P. 20; scale 6-41-4 (to ventrals); depth 3.8 in length; head 4.4.

No. 56x=5061, from Formosa, F. I., doubtless from Taihoku.

19. HEMIBARBUS BARBUS (Schlegel).

Head 3.5 in length; D. III, 7; A. 9; scales 47.

No. 57x=867, Formosa, F. I.

Also recorded from Formosa by Günther. It is similar to specimens from Osaka, except that the snout is a little longer and the dorsal spine stouter.

20. CULTER BREVICAUDA Günther.

Head 4.25; depth 3.25; D. II, 7; A. 28; scales 67; teeth 5, 4, 1-4, 4, 2.

No. 55x=865, F. I. The species was originally described from Formosa.

21. CIRRHINA, species.

Closely allied to *Cirrhina chinensis* Günther. D. 15; A. 7; scales 37; teeth 5, 4, 2.

No. 837, Formosa, F. I.

22. ZACCO PACHYCEPHALUS (Günther).

D. 9; A. 12; scales 53; Head 3.25; depth 3.5; pharyngeal teeth 5, 3, 1; four scales between lateral line and ventrals.

No. 12076, Suwata; 12232, Taihoku. The species was originally described from Formosa, collection of Consul Swinhoe.

The new generic name *Zacco* Jordan and Evermann (*Zakko*, a minnow, in Japanese) may be applied to the group of which *platypus* is the type. It differs from *Opsariichthys* in lacking the peculiar notched jaws of the type (*uncirostris*) of that genus. The anal fin in *Zacco* is much elevated in the males, which are also highly colored (blue and crimson) in the breeding season, the head covered with warts.

23. ZACCO EVOLANS Jordan and Evermann, new species.

Two specimens, No. 877, F. I., and 12231, Taihoku, agree fairly with ordinary Japanese specimens except in the much greater length of the pectorals. Scales 45; pectorals reaching ventrals; anal lobe past front of caudal. Body with about twelve dark cross-bars.

Head 4.25; depth 4.25; eye 3.2; snout 4; interorbital 3; D. 9; A. 11; scales 9-47-4. Body short and very greatly compressed; back somewhat arched; head moderate, mouth rather large, slightly oblique, the jaws subequal, the snout rather pointed; scales very thin, cycloid, lateral line running very low; jaws and cheek with a number of phosphorescent spots; origin of dorsal nearer tip of snout than base of caudal, the fin very high, its rays greater than length of head; caudal forked; anal fin very large, the rays nearly twice the length of head; ventrals short, reaching origin of anal; pectoral long and falcate, half longer than head, reaching middle of ventrals.

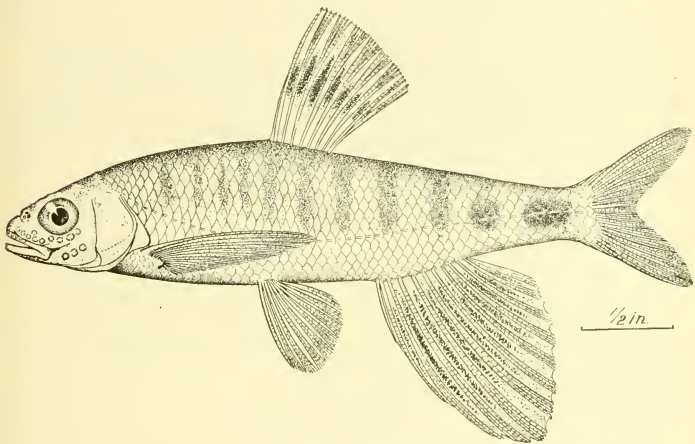


FIG. 5.—ZACCO EVOLANS.

Color in alcohol, silvery-olivaceous above, the side with about eleven broad, dark, plumbeous cross-bars, suggesting the parr marks in a young trout; membranes of dorsal fin dark brown or almost black near center of fin; membranes of anal fin dark; other fins pale.

Type.—No. 12230, a specimen 3.5 inches long, from Taihoku. This is numbered 7129 Stanford University Museum.

24. ACHEILOGNATHUS MESEMBRINUM Jordan and Evermann,
new species.

Head 4; depth 2.8; eye 3.5; snout 4; maxillary 3; mandible 2.5; interorbital 2.5; D. 8; A. 15; scales 8-38-5.

Body short, deep, and very greatly compressed, bearing some resemblance to the American species called *Cyprinella*; head small and pointed; mouth moderate, somewhat oblique, the jaws subequal, maxillary reaching anterior edge of orbit; scales large and well imbricated; lateral line running low, gently decurved under front of dorsal, and

passing along lower third of caudal peduncle; origin of dorsal slightly nearer tip of snout than tip of caudal fin; the fin high, its anterior rays nearly equaling head in length; base of anal oblique, the free edge somewhat concave, the longest rays 1.3 in head; caudal fin lunate; ventrals and pectorals moderate, the latter falcate.

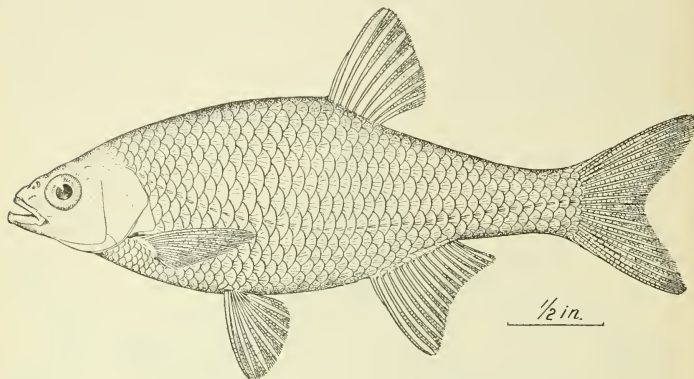


FIG. 6.—ACHEILOGNATHUS MESEBRINUM.

Color in alcohol, yellowish-silvery, without markings anywhere.

Two other specimens, Nos. 12072 and 12078, from Kotosho.

Type.—No. 12235, a specimen 3.5 inches long, from Kotosho, Formosa = 7130 Stanford University Museum.

25. DILLONIA, species.

Allied to *Dillonia aculata* Cuvier and Valenciennes. Head shaped as in *Scaphiodon*. Mandible with barbels; D. 10; A. 11; scales 39.

The specimen of this species from Formosa has been mislaid, and nothing more can be said of it at present.

Family MONOPTERIDÆ.

26. MONOPTERUS ALBUS (Zuiew).

Head 10.5; tail 3.5 in rest of body; No. 12066, F. I.

In another specimen, perhaps not the same species (No. 6448, Hokoto), the tail is a little longer, more than one-third rest of body, and the head 11.5 in length. Much more material is necessary to ascertain whether more than one valid species of *Monopterus* exists.

Family ANGUILLIDÆ.

27. *ANGUILLA MANILENSIS* (Bleeker).

One specimen, No. 1590, from Kotosho. Maxillary teeth in two bands, separated by a longitudinal division, as in *A. bengalensis*; eye large, the cleft of the mouth extending to just below posterior edge of pupil; head somewhat less than distance between front of dorsal and anal; pectoral broad, dark; coloration mottled. This specimen agrees fairly with Bleeker's figure of *Muraena manilensis*.

28. *ANGUILLA MAURITIANA* Bennett.

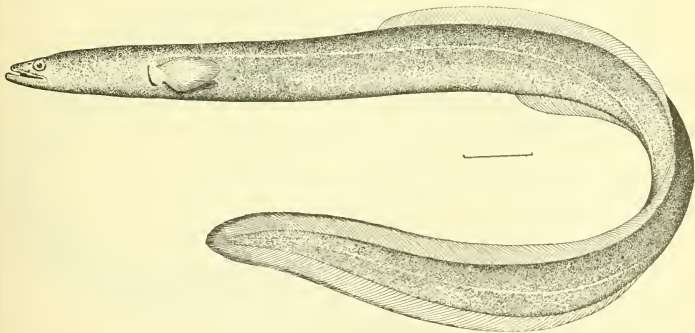
Distance from front of anal to front of dorsal much greater than head; pectoral 2.7 in head; head short, about equal to distance from gill-opening to dorsal fin; eye small, cleft of mouth extending to beyond it; lips very thick; anterior nasal tubes prominent; body much mottled with black. A large specimen, No. 12073, from Kotosho.

29. *ANGUILLA SINENSIS* McClelland.

A small specimen, No. 6447, from Taihoku. It agrees with Günther's account of *A. latirostris*, but that species was originally described from Nice. The long head, greater than the distance from front of dorsal to front of anal, is characteristic of this species.

30. *ANGUILLA REMIFERA* Jordan and Evermann, new species.

Near *Anguilla japonica* Schlegel, but the pectoral much longer, 2.17 in head and rather pointed. Distance from front of dorsal to front of anal slightly more than length of head.

FIG. 7.—*ANGUILLA REMIFERA*.

One specimen, No. 12064 (70), 18.5 inches long, from Hokoto, Formosa, returned to the Imperial University.

Head 9; depth 18; eye 10.5; snout 6. Distance from snout to origin of dorsal less than one-third total length; anal origin about two-fifths total length from tip of snout; dorsal and anal confluent around caudal; pectoral 2 in head; gill-opening small; lower jaw slightly projecting; teeth strong.

Body long and slender, little compressed, except posteriorly; head long, pointed. Color in alcohol, grayish-olive, paler below; caudal and posterior portions of dorsal and anal edged with black.

Family LEPTOCEPHALIDÆ.

31. LEPTOCEPHALUS, species.

One ribbon-shaped larva of some eel or eel-like fish, probably a *Conger*, but not certainly identifiable.

Family OPHICHTHYIDÆ.

32. PISOODONOPHIS BORO (Hamilton-Buchanan).

No. 1591, Toii, and No. 12065, Formosa, F. I.

33. OPHICHTHUS CEPHALOZONA Bleeker.

A small specimen agreeing with *O. cephalozona* in most regards, but the dorsal is lower and the pectoral shorter, 4.7 in head. The coloration is obscure, the body being crossed by obscure paler bands; the markings on the head as figured in *O. cephalozona*. Apparently these variations are due to the immature condition of the specimen.

No. 6449, Hokoto.

Family MURÆNIDÆ.

34. GYMNOTHORAX PESCADORIS Jordan and Evermann, new species.

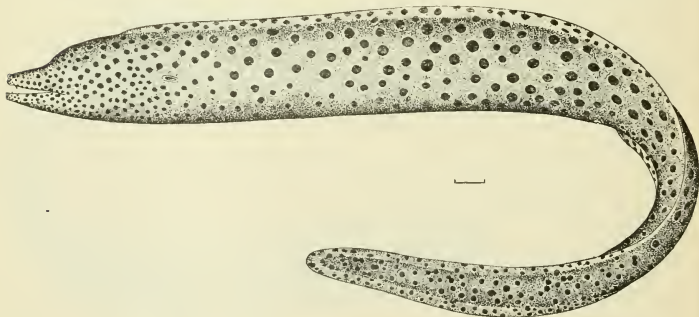


FIG. 8.—GYMNOTHORAX PESCADORIS

Teeth uniserial on side of each jaw; two large, sharp, movable teeth on median line of roof of mouth; eye 2.25 in snout, in anterior half of gape; tail slightly shorter than rest of body.

Color in alcohol, dark olive-brown, covered profusely everywhere with large, roundish, jet-black spots, these largest and most numerous on back and sides, more sparse on belly; spots of jaws and head less regular in shape and very numerous, the interspaces being more nearly white.

Type.—No. 6450, 40 inches long, from Hokoto or Pescadores Islands, No. 7131, Stanford University Museum.

35. *EVENCHELYS MACRURUS* (Bleeker).

Second series of mandibular teeth fewer than as described; posterior vomerine teeth fewer.

A fine specimen, 6.25 feet in length, No. 12063, from Kotosho.

The new genus *Evenchelys* Jordan and Evermann (type, *macrurus*) differs from *Gymnothorax* in the excessively long tail, which is nearly twice the length of the rest of the body.

Family CHANIDÆ.

36. *CHANOS CHANOS* (Forskål).

D. 14; A. 9; scales 92.

Several young examples, Nos. 12067 (Giran), 12238 (Taihoku), 11435, F. I., 12083, F. I., and 876 F. I.

One specimen from Toii.

Family ELOPIDÆ.

37. *ELOPS MACHNATA* Rüppell.

D. 20; A. 14; V. 14; Nos. 12236, Formosa, F. I., and 12237, from Suwata.

38. *MEGALOPS CYPRINOIDES* (Broussonet).

D. I, 8; A. 24; scales 39.

Head 4 in length; depth 3.5. Nos. 871 (Formosa), F. I., and 12069 (Giran).

Family CHIROCENTRIDÆ.

39. *CHIROCENTRUS DORAB* (Forskål).

Head 6.5 in length; depth 7; eye 4.5 in head; D. 17; A. 30. A large specimen, No. 87 x = 868 (Formosa), F. I.

Family DOROSOMIDÆ.

40. *CLUPANODON MACULATUS* (Richardson).

Head 3.7 in length; depth 2.75; D. 16; A. 25; scales 48. Dorsal not inserted much before ventrals; no black spot on shoulder. No. 12068 (Giran). Recorded by Günther from Formosa.

41. CLUPANODON NASUS (Bloch).

D. 17; A. 20; scales 49. Nos. 870, 878=77 x (Formosa), F. I., 12074 (Giran), and 12084 (Kotosho).

Family CLUPEIDÆ.

42. SARDINELLA TOLI (Cuvier and Valenciennes).

D. 18; A. 20. Nos. 12077, and 12085 (Kotosho).

43. ILISHA ELONGATA (Bennett).

Head 3.7; depth 3.3; D. 16; A. 44; V. 5; scales 50,-13; 24 sentes before vent, 12 behind. No. 872 (Formosa), F. I., a very large example.

44. DUSSUMIERIA ELOPSOIDES Bleeker.

Head 4.3; depth 6; D. 19; A. 16; P. 15.
No. 11343 (Kotosho), in bad condition.

Family ENGRAULIDÆ.

45. ANCHOVIA INDICA (Van Hasselt).

(*Engraulis russelli* Bleeker.)

Head 4.5; depth 5.75; D. 16; A. 20; P. 13.
Two specimens, Nos. 12233, F. I., and 12234 (Suwata).

Family SALMONIDÆ.

46. PLECOGLOSSUS ALTIVELIS Schlegel.

Head 4.75; depth 4.75; D. 11; A. 17; V. 8; scales about 133.
Nos. 3832, 3833, and 3834, Taihoku.

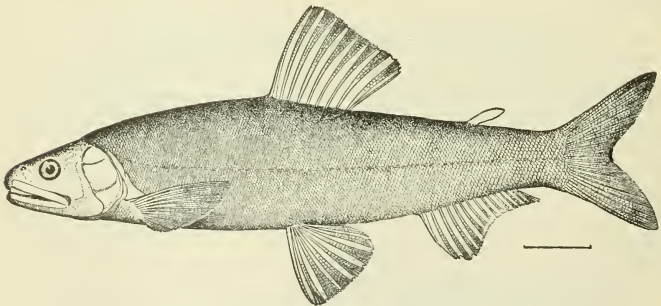


FIG. 9.—PLECOGLOSSUS ALTIVELIS.

These specimens agree with those of the common Ayu of Japan, except that the anal fin is slightly longer, its length being 1.17 in head, nearly twice its longest ray. This difference is doubtless due to their large size, and probably has no taxonomic value.

Family SYNODONTIDÆ.

47. SAURIDA ARGYROPHANES (Richardson).

D. 12; A. 11; scales 52 to 54.

Nos. 11326 and 3836 (Formosa), F. I.

This species is quite different from the Japanese *Saurida japonica*, having the eyes scarcely veiled by the very narrow or adipose eyelid, and the pectoral fin much longer, 1.6 in head, reaching to or beyond front of pectoral. *Saurida japonica* (Wakanoura, Japan) has the pectoral 1.6 in head, not reaching ventrals and reaching about to the eighth scale of lateral line. Head 4.5 in length in *Saurida argyrophanes*; about 5 in *Saurida japonica*.

48. TRACHINOCEPHALUS TRACHINUS (Schlegel).

One specimen from Keerun.

Family BELONIDÆ.

49. TYLOSURUS LEIURUS (Bleeker).

Head 3.25 in length; depth 17; D. 19; A. 24; eye 2.5 in postorbital part of head. Length of pectorals much greater than depth of body, equal to postorbital part of head; no gillrakers.

No. 5059=62x (Formosa), F. I.

50. TYLOSURUS MELANOSTIGMA (Cuvier and Valenciennes).

Head 3.75 in length; depth 14; D. 25; A. 27; eye 2.25 in postorbital part of head; no dark blotches on sides.

No. 3835 (Formosa), F. I.

Family NEMIRAMPIDÆ.

51. HEMIRAMPUS FAR (Forskål).

(*Hemiramphus commersoni* Cuvier).

Head 4.5 in length; depth 5.75; D. 13; A. 11; side with a silvery band and 4 dark spots.

Nos. 11329, 11330, 11436 (Formosa), F. I.

52. HEMIRAMPUS GEORGII Cuvier and Valenciennes

Head 4.5 in length; depth 7.5; eye 1.75 in postorbital region; D. 14; A. 13; scales 50.

Nos. 875 and 879=54x.

53. EULEPTORAMPUS LONGIROSTRIS Cuvier.

One large specimen, No. 3835=17 x (Formosa), F. I.

Family EXOCETIDÆ.

54. *CYPSILURUS SPILONOTOPTERUS* (Bleeker).

Head 4.75 in length; depth 5.5; D. 14; A. 10; scales 50. Pectorals black within; dorsal with a black blotch; second pectoral ray divided; ventrals white.

No. 3838 = 14x (Formosa), F. I.

Family FISTULARIIDÆ.

55. *FISTULARIA PETIMBA* (Lacépède).

Head 2.75; snout 3.75; D. 16; A. 12.

One large example, No. 11437 (Formosa), F. I.

Family OPHICEPHALIDÆ.

56. *OPHICEPHALUS MACULATUS* (Lacépède).

One specimen, No. 38x (Formosa), F. I.

A. 26; scales 53.

One specimen, No. 5096. from Giran.

57. *OPHICEPHALUS TADIANUS* Jordan and Evermann, new species.

Head 3; depth 4.75; eye 8.6; snout 6.2; maxillary 2.65; mandible 2.3; interorbital 5.3; D. 42; longest dorsal ray 3; A. 26; longest anal ray 2.7; ventrals 3.5; pectoral 2.3; scales 6-57-11. Body spindle-shaped, compressed posteriorly, caudal peduncle short, deep and greatly compressed; head long and snake-like, covered with plate-like scales; eye small, anterior; nostrils wide apart, the anterior in a small tube on upper edge of maxillary; mouth oblique, large, the maxillary reaching past orbit; a band of small teeth on outer edge of jaws, a band of large, wide-set, canine teeth on palatines and inner side of lower jaw; upper jaw protractile; dorsal long, of numerous spine-like rays, low anteriorly, gradually lengthening posteriorly; caudal rounded; anal similar to dorsal, but not so long; ventrals very small and short, not reaching vent; pectoral short and rounded; lateral line broken anteriorly, running along center of body from base of caudal to just over second anal ray, thence upward for 2 rows of scales, then forward for 15 rows of scales, thence downward for 1 row, then forward to upper edge of gill-opening, where it ends.

General color in alcohol, olivaceous-brown above, lighter below; belly white, with some yellowish markings; a row of 12 dark olivaceous blotches along base of dorsal, partly on fin and partly on body; below these but above lateral line another row of 8 or 9 similar but larger blotches, extending anteriorly to the middle of upward curve in lateral line; below this another line of about 13 lighter colored and

very irregular blotches, extending from base of pectoral posteriorly along lower edge of lateral line to base of caudal; below this another line of scattered and faint blotches from lower edge of pectoral to posterior end of anal; head color of upper part of body, but streaked with irregular lines of black above; a line of light dusky, as wide as pupil, but becoming nearly as broad as eye at edge of opercle, running from posterior edge of eye to base of pectoral, its lower edge just below upper base of pectoral; below this an irregular line of light brown-olivaceous slightly wider than pupil, running to middle of base of pectoral; head below this pale; dorsal with 2 broken stripes of brown-olivaceous about as wide as pupil; caudal membranes dark, rays pale brown-olivaceous, anal with indications of 4 or 5 dark

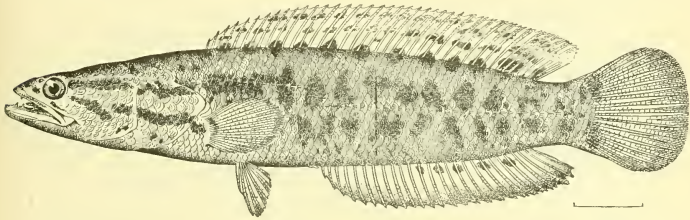


FIG. 10.—OPHIOCEPHALUS TADIUS.

blotches at the base of posterior half, rest of fin pale at base, becoming darker, almost brown-olivaceous toward tips; ventrals pale, dusky; pectoral slightly darker than ventrals.

Type.—No. 3xx, a specimen 9.5 inches long, from Formosa, returned to the Imperial Fisheries Institute.

58. *CHANNA FORMOSANA* Jordan and Evermann, new species.

Head 3.6; depth 5.75; eye 5.75; snout 5.25; maxillary 2.5; mandible 2.25; interorbital 3.5; D. 44; A. 28; scales 454-13. Body moderately long and slender, much compressed posteriorly; head large, broad, depressed and snake-like; mouth large, oblique, the lower jaw slightly projecting, the maxillary reaching posterior edge of orbit; teeth cardiform, in both jaws and on vomer; eye moderate; caudal peduncle short, very deep and very much compressed. Scales large, plate-like, each with strong concentric striae; lateral line very irregular, beginning above opercular opening, extending backward on 7 scales, then running for 8 scales on next row above, then dropping irregularly for 3 or 4 rows over origin of anal, thence continued along median line of side to base of caudal fin. Dorsal fin long, beginning over base of pectoral, the rays quite uniform in length, the last being somewhat longest, being about 2.5 in head; anal similar to dorsal, but shorter, beginning under about the twelfth dorsal ray and ceasing

under the last dorsal ray but two; rays of dorsal and anal all unbranched, but articulated; pectoral short and broad, its tip reaching vent; ventrals absent; caudal broad and rounded.

Color in alcohol, yellowish-brown, the side with about 8 V-shaped imbricated dark crossbars, the apex pointing forward; these crossbars plainest posteriorly, more or less broken and irregular in front; a large, round, black ocellus on caudal peduncle at base of caudal fin as large as eye, bordered by white; side of head with two broad, dark bars extending from eye to posterior edge of opercle; dorsal fin punctulate but with about 2 series of rather distinct white spots on the membrane, extending nearly full length of fin; anal fin plain, somewhat dusky at edge; caudal and pectoral pale, slightly punctulate.

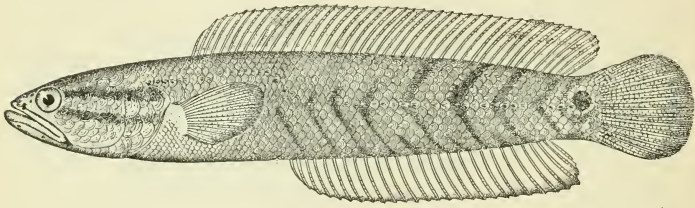


FIG. 11.—CHANNA FORMOSANA.

Type.—No. 5075, a specimen 5.25 inches long, from Sowo or Suwata, Formosa, now numbered 7132 Stanford University Museum; others, No. 269, are from Suwata.

Family MUGILIDÆ.

59. MUGIL OEUR Forskål.

(*Mugil cephalotus* Cuvier and Valenciennes.)

Several specimens, Nos. 5061, 5062 from Giran, 1589 from Keerun, 5067 from Taihoku, 377, 1064 (F. I.) from Formosa.

D. IV-1, 8; A. III, 8; scales 40,-12.

Dark streaks along scales more or less distinct.

60. LIZA TROSCHELI (Bleeker.)

Head 4.1; depth 3.8; eye 3.75; snout 4.5; interorbital 2; D. IV-1, 8; A. II, 10; scales 30,-10; body rather short and stout, the back gently and regularly arched from tip of snout to origin of spinous dorsal; head small, triangular, the interorbital broad and flat; eye rather large, snout short, the adipose eyelid small; teeth small but visible to the naked eye; sides of lower jaw meeting in a broad angle; lips thin; bare space between dentary bones club-shaped, broadest anteriorly, the subopercles overlapping below; pectoral broad and

short, 1.5 in head; ventrals shorter than the pectoral, their length 2.5 times in distance from their base to origin of anal; first dorsal spine 1.75 in head; soft dorsal low, its longest ray 2 in head; origin of spinous dorsal slightly nearer base of caudal than tip of snout, or over tips of ventrals; caudal moderately forked, the lobes equal, their length equal to that of head; anal origin in front of soft dorsal, its free edge concave, its longest rays 1.75 in head.

Color in alcohol, grayish-silvery on side, dark olive on back and top of head; lower parts silvery-whitish; fins dusky, tips of middle caudal rays blackish.

One specimen, No. 5068, 9 inches in total length, from Hokoto, Formosa.

This specimen agrees with *Mugil troscheli* from the East Indies except that the head is wider, the interorbital space twice the eye, and the body deeper 3.75 to 3.8 in length, equal to length of head. These discrepancies are probably due to individual variations or to the immaturity of the original type.

Family SPHYRÆNIDÆ.

61. SPHYRÆNA JELLO Cuvier and Valenciennes.

D. V-I, 9; A. I, 10; scales 17-135-23.

This is doubtless identical with *Sphyræna jello*, but the scales seem smaller, more than 125 in lateral line.

No. 11328 (Formosa), F. I.

62. SPHYRÆNA JAPONICA Schlegel.

D. V-I, 9; A. I, 9; scales 11-87-14.

Nos. 3831; 3839=33x (Formosa), F. I.

63. SPHYRÆNA FORSTERI (Cuvier and Valenciennes).

Scales 110,-16.

Nos. 3831, 880 (34x), Formosa, F. I.

These specimens agree fairly with Günther's account of this species, but the species of this genus need comparative study.

Family AMMODYTIDÆ.

64. BLEEKERIA MITSUKURII Jordan and Evermann, new species.

Two specimens, Nos. 11340 and 11342, from Giran.

Near to *Bleekeria kallolepis* and *B. gilli*, but with smaller scales than either. It is not easy to see why Dr. Day¹ should reject the genus *Bleekeria*, placing its species in *Ammodytes*. *Bleekeria* has well-formed and finely sculptured scales, as well as small teeth in the jaws.

¹ Fishes of India.

In *Ammodytes* there are no teeth and the scales are almost obsolete, the body being crossed by folds of skin. *Ammodytes* is subarctic in distribution, *Bleekeria* is tropical. *Ammodytes* has a much larger number of fin rays and doubtless of vertebrae also.

Head 4.6; depth 8.5; eye 5.2; snout 3.8; D. 42; A. 15. Body long, slender, and somewhat compressed; head very long; mouth rather large, the lower jaw much projecting, a prominent point below; maxillary thin, slipping under the preorbital, reaching orbit. Scales small and firm; lateral line running high, about two scales below dorsal, on caudal peduncle suddenly dropping to middle of caudal fin; dorsal fin long and low, depressible in a groove, its origin over base of pectoral; anal short, terminating under last dorsal ray; pectorals short

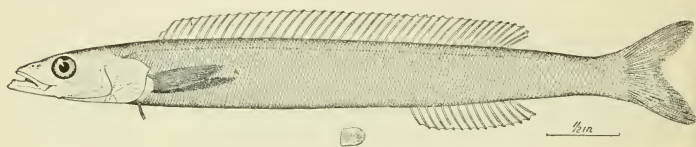


FIG. 12.—BLEEKERIA MITSUKURII.

and pointed; ventrals very minute, slightly in front of pectoral; opercular bones very thin and papery; teeth on front of jaws weak, apparently in villiform patches.

Color in alcohol, plain straw-yellow.

Type.—No. 11340, a specimen 4.25 inches long, from Giran, now No. 7133, Stanford University Museum.

Family HOLOCENTRIDÆ.

• 65. OSTICHTHYS JAPONICUS (Cuvier and Valenciennes).

A large specimen, 1 x, Formosa, F. I.

The genus *Ostichthys* differs from *Myripristis* in the very rough scales and from *Holotrachys* in their very large size, larger than in any species of *Myripristis*.

Family MULLIDÆ.

66. UPENEUS INDICUS (Shaw).

One specimen, No. 1592, from Keerun. Two dark streaks on second dorsal; golden area under first dorsal and dark blotch on caudal peduncle distinct.

One specimen, No. 302, from Giran.

67. UPENEUS CYCLOSTOMUS (Lacépède).

(*Upeneus luteus* Curvier and Valenciennes; Day.)

One specimen, No. 273, from Keerun. It agrees fairly with Günther's account of *U. cyclostomus* and with Day's figure of *U. luteus*. In view of the doubt as to the synonymy of this species, we follow Günther in identifying it with Lacépède's *Mullus cyclostomus*.

68. UPENEOIDES VITTATUS (Forskål).

One specimen, No. 1756, from Keerun. Posterior black band on lower lobe of caudal very broad and black, the coloration unlike that of Hawaiian examples, supposed to be this species, the posterior band broader than in Day's figure.¹

69. UPENEOIDES BENSASI (Schlegel).

One specimen, No. 275, from Keerun. Color, plain except for a dark tip to each dorsal, the color probably faded. Side with dark rivulate markings under each scale. Teeth all small, on jaws, vomer, and palatines. We identify this species with *Upeneoides bensasi* on the supposition that the color is faded. Such faded examples correspond to *Upeneus subvittatus* of Richardson.² Probably the original *subvittatus* of Schlegel also is the same species. The latter has a banded caudal, as in *Upeneoides bensasi*.

Two small specimens, No. 314, from Kotosho are colored as in Japanese specimens of *U. bensasi*. Caudal with four dark bands on the upper lobe, the lower dusky with a whitish edge; first dorsal with three dark cross-bands, the second dusky at tip.

70. UPENEOIDES TRAGULA (Richardson).

Two specimens, Nos. 1755 and 358, from Keerun, agreeing with Day's figure.³

Two specimens, Nos. 303 and 304, from Giran.

One specimen, No. 339, from Formosa, F. I.

One specimen, No. 281, from Hokoto.

Head 3.75; depth 4.2; eye 4; D. VIII-I, 8; A. I, 6; P. 13; scales 32.

Family TRICHIURIDÆ.

71. TRICHIURUS JAPONICUS Schlegel.

One specimen, No. 5064, from Hokoto.

One large specimen, No. 17 x, from Formosa, F. I.

¹Fishes of India, pl. xxx, fig. 2.

³Fishes of India, pl. xxx, fig. 4.

²Ieth. China, p. 219, from Canton.

Family SCOMBRIDÆ.

72. SCOMBER JAPONICUS Houttuyn.

One small specimen, No. 27 x, from Formosa, F. I., of some mackerel, with low suborbital and rather elongate body. It may be *Scomber janesaba* Bleeker, but until these various Asiatic mackerel with air-bladders have been fully compared, we are not certain that any of them is separable from *Scomber japonicus*.

73. SCOMBER KANAGURTA Russell.

A small mackerel, No. 23 x, from Formosa, F. I., the body and especially the head deeper than in *S. japonicus*; the scales much more distinct, the color silvery, the dark markings less distinct. This corresponds fairly with Day's figure¹ of the species he calls *Scomber microlepidotus*. This seems to be different from *Scomber japonicus*.

74. GYMNOSARDA ALLETERATA (Rafinesque).

One specimen, No. 26 x, from Formosa, F. I., in bad condition, the spots behind pectoral obsolete. The identity of this with the Atlantic species is questionable.

75. SCOMBEROMORUS KUHLII (Cuvier and Valenciennes).

One fine specimen, No. 21 x=357, from Formosa, F. I. Body without streaks or spots.

Family CARANGIDÆ.

76. SCOMBEROIDES ORIENTALIS (Schlegel).

One specimen, No. 327, from Giran. This species seems to differ from *Scomberoides toloo* (= *S. sancti-petri*) in the elongate body, the depth being about $\frac{1}{4}$ in length to base of caudal. The maxillary extends not quite to posterior margin of eye.

77. MEGALASPIS CORDYLA (Linnaeus).

(*Scomber rotleri* Bloch.)

A very large specimen, No. 18 x, from Formosa, F. I. Lateral plates extremely large, covering the posterior part of the body with a coat of mail, much larger than in any species of *Carangus*.

A fine large specimen, No. 370, from Formosa, F. I.

78. DECAPTERUS MUROADSI (Schlegel).

One specimen, No. 22 x, from Formosa, F. I.

¹Fishes of India, pl. LIV, fig. 4.

79. DECAPTERUS MACROSOMUS (Bleeker).

One specimen, No. 337, from Formosa, F. I. This species is distinguished by the large number of dorsal and anal rays, and the great development of the lateral plates, 49 + 38, the latter number being that of the keeled plates on the straight part. There is a peculiar angulation of the lower part of the shoulder girdle approaching that in *Trachurops*.

A specimen of this species from Kagoshima, Japan, is in the Imperial Museum at Tokyo.

One specimen, No. 24 x, from Formosa, F. I.

80. TRACHUROPS TORVA (Jenyns).

One specimen, No. 352, from Formosa, F. I.; one specimen, No. 371 = 23 x, from Formosa, F. I.; one specimen, No. 325, from Giran; and one, No. 2070, from Giran.

81. CARANGUS LEPTOLEPIS (Cuvier and Valenciennes).

Two specimens, No. 297, from Keerun. Opercular spot very distinct, encroaching on the shoulder.

82. CARANGUS MALABARICUS (Schneider).

One specimen, No. 272, from Keerun. Dorsal lobe 1.4 in head; depth 2.12 in length (without caudal). Otherwise agreeing with Day's figure and Günther's description.

83. CARANGUS JARRA (Cuvier and Valenciennes).

One specimen, No. 274, from Keerun, referred with doubt to this species. The depth is 2.2 in length, the soft dorsal lobe 1.2 in head; D. VIII-I, 22. Lateral shields large, about 35 developed; breast naked; lateral line scarcely wavy.

84. CARANGUS SEXFASCIATUS (Quoy and Gaimard).

One young example from Keerun. It agrees in essential respects with *Carangus latus* of the Atlantic. D. VIII-I, 20; plates 28 to 30; breast scaly; no distinct opercular spots; body with six broad faint cross-bands; first dorsal and tip of second blackish; anal pale. It agrees in general with Günther's account of *Carangus hippos*, but the true *hippos* is an American species, quite distinct (*Carangus carangus* of Günther).

85. CARANGUS, species.

A small specimen from Kotosho resembling *Carangus jarra* (Cuvier and Valenciennes). D. VIII-I, 23; scales about 30; no spots.

86. *CARANGUS ARMATUS* (Forskål).

A large specimen, No. 17 x, from Formosa, F. I., with opercular spot and very high lobes to dorsal and anal fins.

One specimen, No. 21 x, from Formosa, F. I. Opercular spot present; lobes of dorsal and anal very low.

One specimen, No. 20 x, from Formosa, F. I. No opercular spot; produced anal ray as long as base of fin; ventrals pale.

This specimen corresponds to Cuvier and Valenciennes's figure of *Carangus cirrhosus*, but not to *Olistus malabaricus*, regarded by Günther as a synonym.

One large specimen, No. 349, from Formosa, F. I. Dorsal and anal lobes not extending much beyond middle of fin; opercular spot present.

87. *ALECTIS CILIARIS* (Bloch).

One specimen from Formosa, F. I., and two specimens from Keerun.

Family LEIOGNATHIDÆ.

88. *LEIOGNATHUS EDENTULUM* (Bloch).

Head 3.3 in length; depth 1.7; second dorsal spine 1.3 in head.

Two specimens, Nos. 279 and 297, from Formosa, F. I.

89. *LEIOGNATHUS SPLENDENS* (Cuvier and Valenciennes).

One specimen from Keerun and one fine specimen, No. 329, from Hokoto.

90. *GAZZA EQUULÆFORMIS* (Rüppell).

One specimen, No. 317, from Kotosho. Depth 2.5 in length to base of caudal. Second dorsal spine about 2.7 in depth as in *G. equulæformis*. Axil black; spinous dorsal dusky anteriorly; some vague dark spots along lateral line.

One specimen, No. 328, from Hokoto.

Family STROMATEIDÆ.

91. *APOLECTUS NIGER* (Bloch).

A large specimen, No. 27 x, from Formosa, F. I. No ventral fins; caudal fin with a strong keel, suggesting that of *Carangus*, the scales on the keel thickened but without spines; color, pale grayish; gill-openings very broad, the membranes not attached to the isthmus.

Head 3.8; depth 2.1; eye 5.6; snout 3.25; maxillary 3.4; mandible 3; interorbital 2.75; preorbital 10; D. 40; highest dorsal ray 1.1; A. 37; longest anal ray 1.3; scales about 27-97-50, rubbed off and difficult to count; pectoral very long and narrow, 1.3 times the head. Body oblong-rhombic, greatly compressed, dorsal and ventral outlines con-

siderably arched; dorsal profile from snout to origin of dorsal fin regularly curved; head moderate, the snout rather blunt; mouth moderate, somewhat oblique, the jaws subequal; maxillary broad, reaching front of orbit, slipping under preorbital for its entire length; teeth setiform, slender, and very weak in each jaw; top of head trenchant; nostrils oblong, very close together; eye moderate, partially covered by adipose membrane, slightly above level of upper lip; preorbital narrow. Cheek deep; edges of opercular bones membranaceous, the opercle very thin and flexible; caudal peduncle depressed, and strongly keeled. Scales small, cycloid, somewhat irregularly placed; cheeks and opercles with fine scales; a large naked area from snout between eyes to occiput; dorsal and anal densely covered with thin scales;

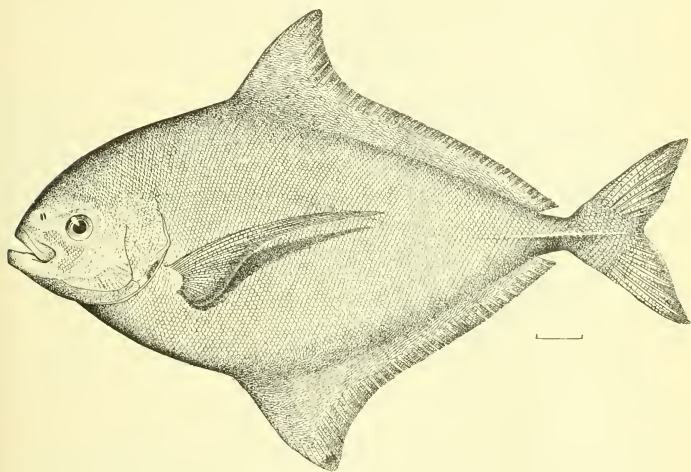


FIG. 13.—*APOLECTUS NIGER*.

caudal with less complete squamation; dorsal fin elevated in front, distance of its origin from snout 1.4 in its base; anal similar to dorsal, its origin more posterior; caudal widely forked.

Color in alcohol, dirty yellowish-white, without markings, except a narrow black blotch on edge of opercle.

Family PEMPHERIDÆ.

92. *PEMPHERIS NYCTEREUTES* Jordan and Evermann, new species.

A single large specimen from Hokoto. It does not fit Dr. Döderlein's description of *Pempheris japonicus* very well, and the small size of the scales separates it still further from the others described.

Head 3.4; depth 2.4; eye 2.5; snout 5.5; maxillary 2; mandible 1.75; interorbital 4; D. V, 9; longest dorsal ray 1.5; A. III, 44; longest anal spine 3.6, ray 2.8; scales 80 in lateral line; those above and below are rubbed off and not to be counted accurately. Body oblong, compressed; long base of anal very oblique; lateral line concurrent with the dorsal outline and extending to tip of tail; head compressed; eye large; snout very short, blunt; mouth large, very oblique; villiform teeth on vomer, palatines, and jaws; maxillary extending to below middle of eye; dorsal short, slightly behind ventral; anal very long, low and densely scaled at base; ventral spine as long as rays; pectoral broad, falcate, 1.2 in head; scales deciduous, those of lateral line most persistent.

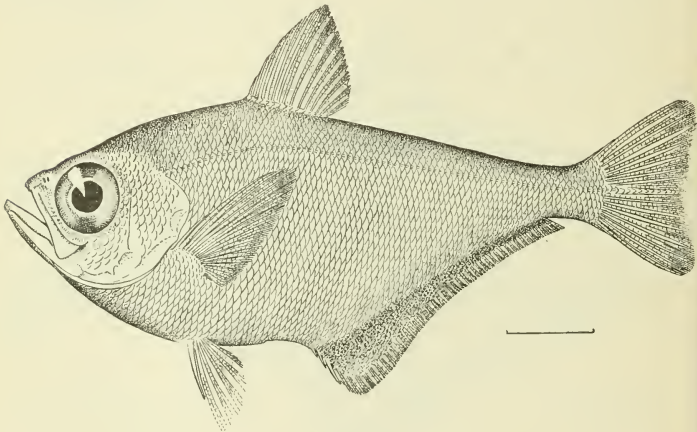


FIG. 11.—PEMPHERIS NYCTEREUTES.

General color in alcohol, olivaceous brown; pectoral and ventrals pale; base of anal dusky brown; throat and under parts of head rusty brown.

Type.—No. 286, a specimen 8 inches long from Hokoto, Formosa, returned to the Imperial University.

Family KUHLIIDÆ.

93. KUHLIA MARGINATA (Cuvier and Valenciennes).

One specimen, No. 319, from Kotosho, agreeing fairly with Boulenger's description.

Family SERRANIDÆ.

94. PSAMMOPERCA WAIGENSIS (Cuvier and Valenciennes).

One fine specimen, No. 340, from Formosa, F. I.

95. LATEOLABRAX JAPONICUS (Cuvier and Valenciennes).

One specimen, No. x z, from Formosa, F. I., and one specimen from Keerun.

96. EPINEPHELUS TAUVINA (Forskål).

(*Serranus salmoides* Day.)

Three specimens from Keerun, agreeing with Boulenger's description. Other specimens from Formosa are in the British Museum. One specimen, No. 376, with faint spots and with a broad black streak above maxillary.

97. EPINEPHELUS MERRA Bloch.

One specimen from Keerun. It belongs to the typical variety *merra* in Boulenger's Catalogue (I, p. 242).

98. EPINEPHELUS FUSCOGUTTATUS (Forskål).

One specimen, No. 3 x, from Formosa, F. I.

99. EPINEPHELUS EPISTICTUS (Schlegel).

One specimen, No. 280, from Giran, identical with one taken by us at Nagasaki. This species is near to *E. latifasciatus*, but is marked by spots only, not bands or stripes. A series of round blackish spots runs from the eye to the base of caudal. The spines on angle of preopercle are well developed.

One large specimen, No. x 7, from Formosa, F. I. Back sparsely covered with small round dark spots, no trace of dark lines; otherwise very near to *Epinephelus latifasciatus*, of which it may prove a color variation.

100. EPINEPHELUS CHLOROSTIGMA (Cuvier and Valenciennes).

One specimen, No. 345, from Formosa, F. I. The spots are less numerous than are shown in the figures of Day and Bleeker, but the general characters agree with Boulenger's description.

One large specimen, No. 363, Formosa, F. I., corresponding to Day's figure of *Serranus arcuatus*.

101. EPINEPHELUS DIACANTHUS (Cuvier and Valenciennes).

One small specimen, the dark cross-bands scarcely traceable; a dark streak above maxillary.

A fine specimen, No. 374, from Formosa, F. I. Angle of opercle with two rather strong spines.

One small specimen, No. 355, Formosa, F. I., referred with doubt to this species. There are no dark cross-bands; body with darker spots, which form reticulations, some of them more or less longitudinal; fins unspotted, darker near the edge; a dark streak above maxillary.

102. EPINEPHELUS HÆDTI (Bleeker).

One specimen, No. 4 x, from Formosa, F. I. Head and body closely dotted with darker; caudal and anal broadly edged with black; ventrals chiefly black; dorsal with a brownish edge; pectoral plain yellow.

It is possible that Boulenger is correct in referring this species to the synonymy of *Epinephelus flavoceruleus* (Lacépède), a species having the body plain blue or purple, the fins bright yellow.

103. PROMICROPS LANCEOLATA (Bloch).

(*Phrynotitan gigas* Günther.)

One young example, No. 5 x, from Formosa, F. I.

Family LUTIANIDÆ.

104. GLAUCOSOMA BURGERI Richardson.

One large specimen, No. 364, 17 inches long, from Keerun, Formosa. Inside of mouth black; peritoneum black. This species seems

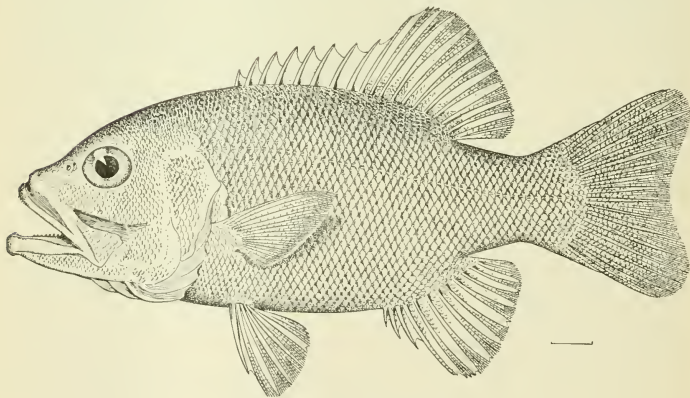


FIG. 15.—GLAUCOSOMA BURGERI.

distinct from *Glaucosoma hebraicum* Richardson. The genus belongs apparently to the *Lutianidæ*, although the extension of the lateral line on the caudal fin suggests relationship to *Lates* and *Psammoperca*. The caudal fin is very slightly lunulate.

Head 2.75; depth 2.4; eye 3.8; snout 3.8; maxillary 1.65; mandible 1.6; interorbital 5; preorbital 7.3; D. VIII, 12; longest dorsal spine 3.5, ray 1.9; A. III, 10; longest anal spine 4, ray 2; ventral 2; pecto-

ral 1.9; scales 12-52-20. Body rather short and deep, compressed; caudal peduncle compressed and deep, its least width 1.65 in eye, its least depth 2.5 in head; back gently and regularly arched from snout to caudal peduncle, somewhat depressed in front of eyes; head large and deep; mouth very large, somewhat oblique, jaws subequal; maxillary very broad at tip, scarcely slipping under preorbital; teeth in a strong villiform band on upper jaw composed of two rows, the outer in front canine-like; those of lower jaw in one series, except in front, where they are somewhat irregular; a large patch of villiform teeth on tongue and hyoid bone; a narrow V-shaped patch on vomer, apparently none on palatines; eye very large, rather high; nostrils close together, the posterior the larger. Scales moderate, weakly ctenoid, covering entire head, body and bases of dorsal, caudal and anal; maxillary densely scaled; base of pectoral scaled; preopercle at the angle with blunt coarse teeth. Fins moderate; dorsal spines rather short but strong, the soft part of dorsal somewhat elevated; anal similar to soft dorsal, the third spine considerably longest; caudal moderate, shallowly lunate, the lobes rounded; pectoral short and broad; ventrals scarcely reaching vent.

Color in alcohol, rusty silvery; head darker, somewhat purplish; edges of scales on side darkish, the bases brassy; dorsal, anal and caudal dusky; pectoral and ventral pale; a large brownish blotch on membrane below preorbital.

105. LUTIANUS FULVIFLAMMA Forskål.

(?*Lutianus hoteen* Richardson.)

A single specimen, badly faded, No. 332, from Keerun. It is identical with another received from Okinawa, and probably belongs to *Lutianus hoteen*, which Günther identifies with *L. fuscescens* from Celebes. In its dull olive coloration it approaches *L. hoteen* rather than *L. fulviflamma* Richardson, with which it agrees in the indistinctly notched preopercle.

It is not unlikely, however, that this is identical with the species figured by Dr. Day as the typical *Lutianus fulviflamma* as distinct from the golden-streaked *Lutianus russelli*.

Two specimens from Keerun. One large specimen, No. 344, from Formosa, F. I.

106. LUTIANUS ANNULARIS (Cuvier and Valenciennes).

One specimen, No. 291, from Formosa, F. I. Black blotch on caudal peduncle above very distinct, bordered before and behind by white; faint dark streaks along the rows of scales, those above oblique, those below horizontal, no trace of streak from first dorsal spine to eye. D. XI, 13; A. III, 8; scales 53.

107. *LUTIANUS ARGENTIMACULATUS* (Forskål).*(Mesoprion gembra* Günther.)

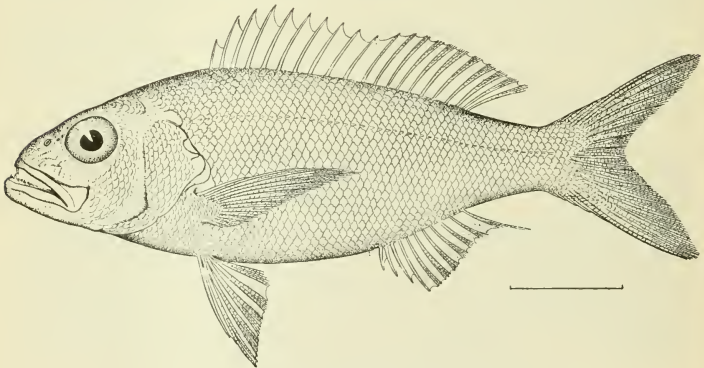
One specimen from Keerun. This species has much in common with *Lutianus argentiventris* and other American species. The parietal crest extends nearly to the point of junction of the supraoccipital crest and orbital rim, indicating that the genus *Neomivnis* will be found untenable.

108. *LUTIANUS VITTA* (Cuvier and Valenciennes).

One specimen from Keerun.

109. *PLATYINIUS SPARUS* (Schlegel).*(Mesoprion sparus* Schlegel.)

Head 3; depth 2.9; eye 3.2; snout 3.5; maxillary 2.25; mandible 1.9; interorbital 4; preorbital 6.25; D. X, 11; longest dorsal spine 2.75 in head; ray 2.75; A. III, 8; pectoral 1.25; ventral 1.7; scales

FIG. 16.—*PLATYINIUS SPARUS*.

10-50-15. Body rather short, deep and compressed; dorsal and ventral outlines gently arched, occipital region slightly depressed; head large; mouth large, somewhat oblique, the lower jaw slightly the longer; maxillary broad, slipping for its entire length under the broad preorbital; eye large; nostrils very small; preopercle strongly serrate at angle. Scales small, nearly cycloid; cheek and opercle scaled, caudal fin scaled at base. Fins moderate, last ray of anal considerably produced.

One specimen, No. 367, 6.25 inches long, from Formosa, F. I. No scales at base of dorsal or anal fins; band of scales at the temples separated from those behind it; scales above lateral line in series

parallel with lateral line; two strong canine teeth in front of each jaw, besides smaller lateral canines; teeth on vomer in a small V-shaped patch; no teeth on tongue; last ray of dorsal and anal produced; caudal deeply forked; gillrakers long, rather few in number, about 12 below angle; 6 rows of scales on cheek; preopercle scarcely notched, with fine long cirri; preorbital not so broad as eye.

Color, apparently bright red, now faded to silvery; cheeks bright silvery.

Platyinius sparus has the skull of *Etelis* and *Aprion*, the compressed form of *Platyinius*, and the strong canines of *Lutianus*. Its nearest ally is doubtless *Platyinius macrophthalmus*, but it should be placed in a genus distinct from *Aprion*, characterized by the robust anterior canines.

110. DENTEX HYPSELOSOMUS Bleeker.

Head 2.75; depth 2.2; eye 3.8; snout 2.4; maxillary 2.6; mandible 2.5; interorbital 3.75; preorbital 3.75; D. XII, 10; longest dorsal

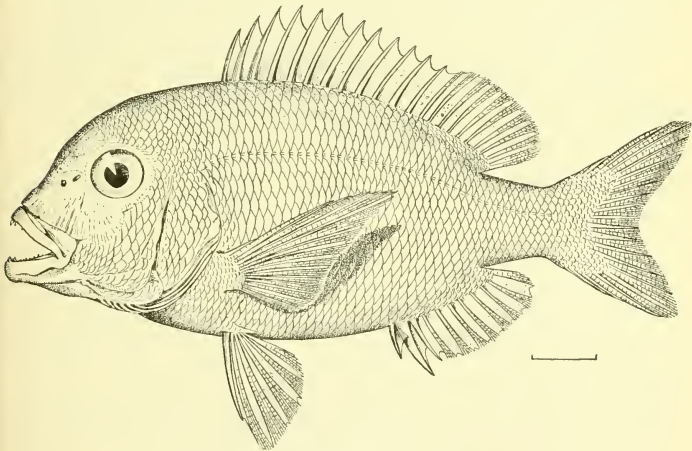


FIG. 17.—DENTEX HYPSELOSOMUS.

spine 2.5; ray 3.2; A. III, 8; longest anal spine 3; ray 3.2; ventrals 1.8; pectoral 1.2; scales 6–50–13. Body short, deep, and compressed, back considerably elevated and trenchant; the anterior profile concave in front of eyes and with a hump above; caudal peduncle moderately compressed, its least width 2 in eye, its least depth slightly greater than eye; head large and deep, mouth large, somewhat oblique, the jaws equal; maxillary heavy, slipping for most its length under the broad, thin preorbital; premaxillaries considerably protractile; teeth

in jaws in an irregular sparse row, broadened into a patch anteriorly; tip of each jaw with 4 large, stout, recurved canines, behind which are the smaller, blunter teeth; no teeth on vomer, palatines, or tongue; eye large, rather high, entirely above upper lip; nostrils remote, the anterior small and round, the posterior larger and ovoid; preorbital very deep; edge of preopercle crenulate; opercle ending in a broad, flat point. Scales large, cycloid, firm, the exposed part much deeper than long; forehead, snout, and preorbital naked; posterior part of cheek and opercles with large scales; nape with smaller scales; a few scales on base of pectoral, and many fine scales on caudal. Fins moderate, the dorsal and anal each folding down into a scaly sheath at base; dorsal spines rather long and slender; anal spines heteracanthous, the second much broader than the others; ventrals not reaching vent; pectoral longer, reaching origin of anal.

No. xx, a specimen 11 inches long, from Formosa, and No. 366 from Formosa.

Forward very gibbous, with a slight concavity above the projecting snout; canines very strong; lateral teeth small, two-rowed, slightly bluntish, not molar-like. Pectoral 3.3 in length; canines $\frac{1}{4}$. Silvery in spirits, doubtless crimson in life, the space between the eyes paler.

111. NEMIPTERUS VIRGATUS (Houttuyn).

(*Synagris sinensis* (Lacépède) Günther; *Dentex setigerus* Cuvier and Valenciennes.)

One specimen, No. ix, from Formosa, F. I.

One specimen, No. 333, from Keerun. The depth of body is 3.5 in length (without caudal) in this common Japanese species, not 4, as stated by Günther.

112. NEMIPTERUS MATSUBARÆ Jordan and Evermann, new species.

Head 3.5; depth 3.5; eye 4; snout 3; maxillary 2.5; mandible 2.2; interorbital 6; preorbital 4.2; D. X, 9; longest dorsal spine 2.5; ray 1.75; A. III, 8; longest anal spine 3, ray 1.9; ventral 1, reaching origin of anal; pectoral 1.2; scales 4-48-9; scales on cheek in 3 rows. Body oblong, compressed, deepest through base of ventral; caudal deeply forked; head subconic; preorbital almost as deep as eye; mouth low, anterior profile in a long, gentle curve; eye moderate; maxillary reaching anterior edge of pupil; mouth moderate, horizontal; no teeth on vomer, palatines, or tongue, a single row of small cardiform teeth on sides of each jaw, in lower jaw this row widens into a band of villiform teeth, anteriorly, those in front slightly larger; lower jaw without canines; front of upper jaw with about 8 large, curved canine teeth; dorsal outline a straight line to base of caudal; soft dorsal slightly higher than spinous portion; first anal spine shortest, fin gradually lengthening to last ray; ventral and pectoral long and narrow; no filaments on the fins.

Type.—No. 5071, specimen 10.6 inches long, from Giran, Formosa, returned to the Imperial University of Tokyo.

Head 2.5 (2.6 without flaps); depth 3.2; eye 5; snout 4.5; maxillary 2; mandible 1.7; interorbital 7.75; suborbital 12; D. XI, 13; A. III, 8; scales 22–110–40. Body short and compressed; head large, pointed; mouth very large, oblique, the lower jaw slightly projecting; maxillary long, reaching posterior edge of orbit; teeth strong, canine-like in jaws, the band broadening in front where the outer teeth are enlarged; patch of teeth on vomer and palatines, none on tongue; eye rather large; preopercle serrate, with 3 strong spines at the angle; opercle with 3 flat spines, the middle one strongest; nostrils small, in front of dorsal third of eye; interorbital narrow; caudal peduncle much compressed, its least depth 3.75 in head, with flap. Scales very small, covering body and entire head; lateral line slightly arched above

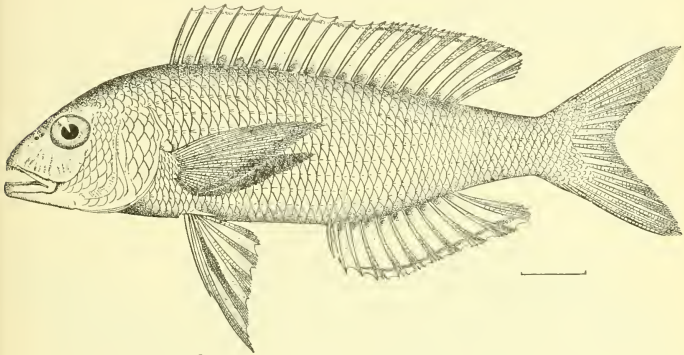


FIG. 18.—*NEMIPTEBUS MATSUBARE.*

the pectoral. Fins rather high; origin of dorsal over opercular spines; origin of anal under first dorsal ray; pectoral rather long and broad, reaching vent; ventrals scarcely reaching vent.

Color in alcohol, light brown; upper two-thirds of body, opercle, and nape with sparse, small roundish dark brown spots; dorsal, caudal, and anal with similar spots, fewest on anal.

One specimen 8 inches long, from Giran, Formosa.

General color in alcohol, pale dusky gray with silvery reflections, and some slight indications of dark in narrow lines on edge of scales along lateral line, and over body posterior to front of anal; dorsal and anal dark at base, this dark being in crescent spots as large as pupil on anterior base of membrane, rest of fin pale; caudal and pectoral pale; ventrals pale, except the third ray, which is yellow; this yellow extends on to the posterior base of the first and second rays; dorsal with a light yellow edge, anal with a yellow median stripe and a yellow edge.

Family HLEMULIDÆ.

113. THERAPON THERAPS (Cuvier and Valenciennes).

One specimen from Keerun.

114. THERAPON CANCELLATUS (Cuvier and Valenciennes).

One specimen from Kotosbo, agreeing fairly with Bleeker's figure.

115. THERAPON QUADRILINEATUS (Bloch).

One specimen, No. 284, from Giran, agreeing with the account given by Dr. Günther. One specimen from Keerun.

116. THERAPON JARBUA (Forskål).

(*Therapon serrus* Cuvier and Valenciennes.)

One specimen, No. 7 x, from Formosa, F. I.

117. PLECTORHYNCHUS OCYURUS Jordan and Evermann, new species.

Head 3.75; depth 3; eye 3.5; snout 3.5; maxillary 3.2; mandible 3; interorbital 4; preorbital 9.5; D. XIV, 18; longest dorsal spine 2.3, ray 3; A. III, 8; longest anal spine 2.5, ray 2.5; ventral 1.5; pectoral

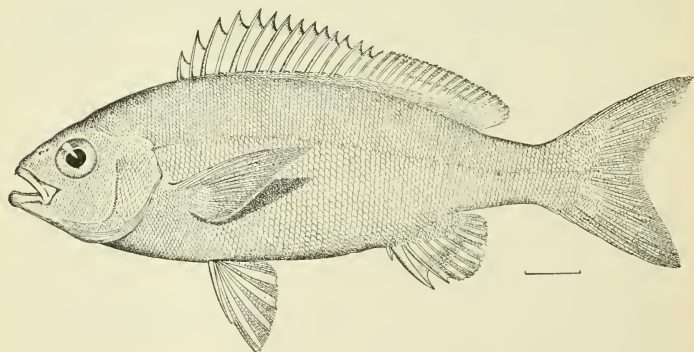


FIG. 19.—PLECTORHYNCHUS OCYURUS.

1.2; scales 19-115-21. Body rather long and compressed, the dorsal and ventral outlines about equally arched; nape rather trenchant; head moderate, pointed, jaws equal; maxillary broad at tip, slipping under preorbital for its entire length; teeth on jaws in a moderately broad band, the outer in front enlarged and canine-like, especially in upper jaw; no teeth on vomer, palatines, or tongue; eye very large, on level of upper lip; nostrils small, close together, oval, on level of upper edge of orbit; preopercle with numerous rather strong, slender

teeth. Scales small, ctenoid, densely covering entire head and body and extending considerably upon caudal fin; a scaly sheath at base of anal and dorsal; lateral line nearly straight, an occasional scale without a pore. Fins rather high; the dorsal spines long, sharp, and slender; second anal spine strong; caudal somewhat lunate; the pectoral long and somewhat falcate, reaching tips of ventrals.

Color in alcohol, yellowish-olive, somewhat rusty on head; membrane of spinous dorsal edged with black; a faint dark line through middle of soft dorsal; anal dusky, pale at tip.

Type.—No. 347, a specimen 12.5 inches long, from Formosa, returned to the Imperial Fisheries Institute.

118. *PLECTORHYNCHUS RADJABAN* (Lacépède).

(*Diagramma punctatum* Cuvier and Valenciennes.)

A large specimen, No. 372, from Formosa, F. I. Body unspotted; dorsal and caudal with black spots, thus corresponding to *Diagramma cinerascens* Cuvier and Valenciennes. D. X, 21.

One specimen, No. 346, from Formosa, F. I.

119. *PLECTORHYNCHUS PÆCILOPTERUS* (Cuvier and Valenciennes).

One specimen, No. 270, from Keerun. One specimen, No. 305, from Giran.

120. *POMADASIS HASTA* (Bloch).

Two specimens from Keerun. Spots on back obscure; on spinous dorsal very distinct.

One large specimen, No. 353, from Formosa, F. I.

121. *POMADASIS MACULATUS* (Bloch).

One specimen from Keerun. The snout a little more blunt than in Day's figure.

122. *SCOLOPSIS VOSMERI* (Bloch).

(*Scolopsis japonicus* Bloch; *Scolopsis torquatus* Cuvier and Valenciennes.)

One specimen, No. 331, from Keerun. White nuchal band very conspicuous; each scale with a dark blotch surrounded by pearly blue. The name *vosmeri* (1790) has priority over that of *auratus* (1797). According to Dr. Day, *Scolopsis torquatus*, which our specimen represents, is the young of *S. vosmeri*.

123. *SCOLOPSIS MONOGRAMMA* (Kuhl and Van Hasselt).

One specimen from Giran, No. 287, agreeing with the account given by Cuvier and Valenciennes. A rather broad dark band extends below the lateral line from the head to base of caudal, broader mesially and bordered above and below by pale.

One specimen, No. 306, from Keerun.

124. *CÆSIO CHRYSOZONA* (Kuhl and Van Hasselt).

One specimen from Keerun.

125. *CÆSIO TILE* Cuvier and Valenciennes.

A small specimen in poor condition from Keerun, the dusky lateral band almost obliterated, probably belongs to this species. Axillary spot distinct; each caudal lobe with a broad dusky lengthwise band; side of body apparently with a broad dark longitudinal band. D. X, 16.

Family SPARIDÆ.

126. *LETHRINUS LEUTJANUS* (Bloch).

One large specimen, No. 334, from Formosa, F. I.

One specimen, No. 310, from Giran. The pearl-colored spots on the scales are still very distinct.

127. *LETHRINUS RICHARDSONI* Günther.

One specimen corresponding very closely to Richardson's figure.¹

128. *PAGRUS MAJOR* (Schlegel).

One large specimen, No. XII, from Formosa, F. I.

A large specimen, No. 373, from Formosa, F. I.

129. *PAGRUS CARDINALIS* (Schlegel).

One specimen, No. 13 x, from Formosa, F. I.

130. *ARGYROPS LONGIFILIS* (Cuvier and Valenciennes).

One specimen, No. 318, from Kotosho. This species seems to be distinct from *Argyrops spiniferus*; the body is a little deeper depth 1.9), and the third, fourth, fifth, and sixth spines have fleshy-like filaments reaching almost to end of caudal. The genus *Argyrops* of Swainson differs from *Pagrus* in its filamentous dorsal, a character of doubtful value.

131. *SPARUS BERDA* Forskål.

One specimen, No. 10 x, from Formosa, F. I. It agrees with *Chrysophrys dainia* of Day in the anal spines and with *C. berda* in the width of the preorbital. It is not unlikely that Günther and Steindachner are right in referring all of these to one species.

132. *SPARUS LATUS* Houttuyn.

(*Chrysophrys avies* Schlegel.)

One specimen, No. 5072, from Giran.

¹Voy. Sulphur, pl. LXIV, fig. 1.

Family SCLENIDÆ.

133. *CORVULA ARGENTATA* Houttuyn.

One specimen, No. x 71, from Formosa, F. I. It seems to agree with *Corvula argentata* (= *Sciæna schlegelii* Bleeker) from Japan, but the soft dorsal rays are fewer (I, 23), the teeth are rather stronger than usual, and the black markings on first dorsal more distinct.

Family PENTACEROTIDÆ.

134. *ANOPLUS BANJOS* Bleeker.

One specimen, No. 285, from Formosa, F. I., similar to Japanese examples.

Family POLYNEMIDÆ.

135. *POLYDACTYLUS PLEBEIUS* (Broussonnet).

A small specimen, No. 324, from Kotosho. Scales about 50; pectoral filaments 5, the longest reaching beyond ventrals. The specimen is in bad order and the identification not quite certain.

136. *POLYDACTYLUS RHADINUS* Jordan and Evermann, new species.

Head 3.6; depth 4.6; eye 4.5; snout 9; maxillary 1.7; interorbital 5; D. VII-I, 15; A. III, 16; scales 10-89-12; pectoral 1.4; ventrals 2.5. Body long and slender, compressed, the back not much elevated; head

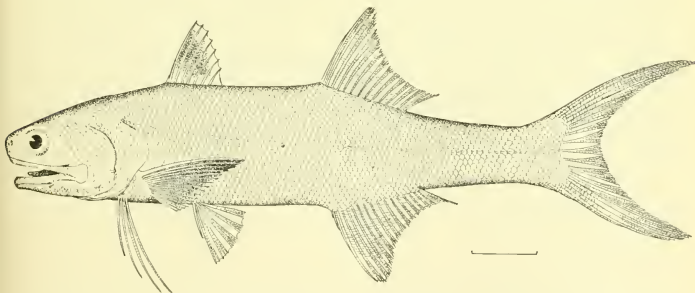


FIG. 20.—*POLYDACTYLUS RHADINUS*.

long, pointed, the snout blunt; mouth very large, nearly horizontal, the lower jaw much the shorter, the snout greatly projecting; maxillary very long and slender, projecting far behind the eye; teeth in jaws in broad setiform bands, covering the jaws not only on top but extending far down both sides; preorbital very narrow; eye covered largely by adipose membrane; caudal peduncle long and slender. Dorsal fins two; remote, the anterior of slender spines only, inserted

in front of ventrals; second dorsal high, the free margin concave, anal similar to soft dorsal, the last ray more produced; caudal ray deeply lunate, the lobes much produced and falcate; pectoral moderate, somewhat falcate, four filamentous rays widely detached and nearly equal to head in length; ventrals short. Scales rather small, smooth, thin, and deciduous; lateral line extending upon lower lobe of caudal which is scaled at base.

Color in alcohol, silvery, the spinous dorsal and pectoral fins dark, anterior edge of second dorsal also dark; detached pectoral rays white.

Type.—No. 17 x, a specimen 10.75 inches long, from Formosa, F. I., returned to the Imperial Fisheries Institute.

Family GERRIDÆ.

137. *XYSTÆMA FILAMENTOSUM* (Cuvier and Valenciennes).

One specimen, No. 323, from Kotosho.

Dorsal filament broken. Faint, roundish, brownish spots present as shown in Bleeker's figure, these arranged in vertical cross rows; obsolete dark spots at base of dorsal rays. Depth 2.4 in length; scales 46.

One fine specimen, No. 40 x, from Formosa, F. I.

Family POMACENTRIDÆ.

138. *GLYPHISODON SAXATILIS* (Linnæus).

Head 2.5 in length; depth 2; D. XIII, 13; A. II, 12; scales 5–30–12.

Dark bands 5, about as broad as the interspaces, the first from the nape to the axil forming a black spot on the pectoral; two below the spinous dorsal, the fourth under front of soft dorsal, the last under caudal peduncle; spinous dorsal dusky; soft dorsal and anal dusky at base and tip; caudal plain, without dark margin above or below.

This is *Glyphisodon celestinus* (the variety with plain caudal) of Günther and Bleeker, and corresponds fairly to Bleeker's fig. 5 in Pl. IX, in Bleeker's Atlas of the Pomacentridæ. But the true *Glyphisodon celestinus* has the caudal edged above and below with blackish. Whether this character is of distinctive value we have not the material to decide.

The names *Chaetodon saxatilis* and *Chaetodon rotundus* of Linnæus seem to belong to the present species. The American species, heretofore called *Glyphisodon saxatilis*, is a different species, having six black bands, the body deeper and the bands narrower. This may stand as *Glyphisodon marginatus* (Bloch). The Hawaiian species *Glyphisodon abdominalis* (Cuvier and Valenciennes), with deeper body and very narrow crossbands, is also different, although more like *G. marginatus*. It is not certain whether this species or *G. celestinus* is the original of *Chaetodon saxatilis*, or indeed that the two forms are really distinct,

but the name may be applied provisionally to the present form. We have numerous young examples of *Glyphisodon saratilis* from Misaki.

Sparus fasciatus Gronow and *Labrus scrofasciatus* Lacépède are probably referable to this species or to *G. celestinus*. *Chaetodon tyrwhitti* seems to be *G. celestinus*. *Glyphisodon rahti* Cuvier and Valenciennes, from the Red Sea and elsewhere, is said to have the fourth band under the second half of the spinous dorsal. It is, however, doubtless identical with *G. saratilis*. No. 294. Formosa, F. I.

139. GLYPHISODON SORDIDUS (Forskål).

One specimen from Kotosho similar to others from Hawaii and Misaki.

Family LABRIDÆ.

140. CHÆROPS AZURIO Jordan and Snyder.

(*Chærops japonicus* (Cuvier and Valenciennes); not *Labrus japonicus* Houttuyn.)

One specimen from Keerun.

141. CHÆROPS NYCTEMBLEMA¹ Jordan and Evermann, new species.

A large specimen, 18 inches long, No. 356, Formosa, F. I., returned to the Imperial Fisheries Institute.

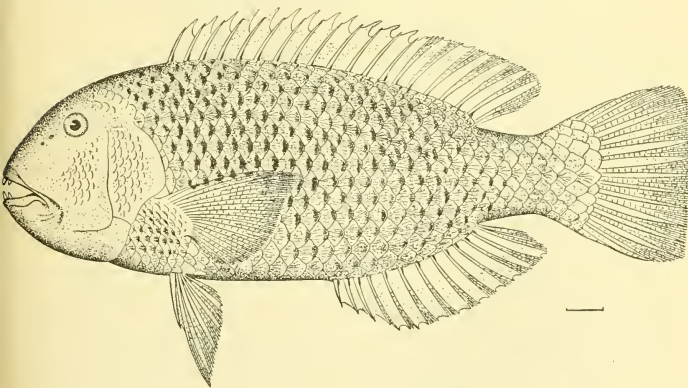


FIG. 21.—CHÆROPS NYCTEMBLEMA.

In the mouth is a card with these notes in Japanese: "Body with rows of purplish spots. Iris and chin blue."

Head 3.5; depth 2.7; eye 6.8; snout 2.2; interorbital 3.8; preorbital 2.7; D. XIII, 7; longest dorsal spine 3.5, ray 2.1; A. III, 10; longest anal spine 4, ray 2; ventral 1.5; pectoral 1.2; scales 5-30-9.

¹The name νύξ, night, ἐμβλήμα, banner, refers to the black flag, the emblem of Formosa.

Body short, stout and compressed; anterior profile very steep, in a strong curve from tip of snout to origin of dorsal fin; head large; mouth large, the gape reaching middle of eye; jaws armed each with about four large, strong canines in front, with short, blunt, coalesced teeth on sides; three somewhat stronger close-set canines at base of upper jaw; eye moderate, high up; caudal peduncle deep and much compressed. Scales very large, thin, and adherent, those on cheek much reduced. Dorsal fin long, moderately high, and beginning over base of pectoral; anal beginning under twelfth dorsal spine, the last rays somewhat produced; caudal squarely truncate; pectoral broad, fan-shaped, the upper rays the longer; ventrals long and pointed, reaching vent, coterminous with the pectoral.

Color in alcohol, dirty olive-brown, scales of side and breast broadly edged with black or dark brown, irregular hair-like lines of dark over rest of scale; lateral line dark; base of pectoral dark, with a broad blue line through it; upper edge of pectoral with dark blotches; caudal peduncle with about 6 longitudinal series of oblong bright blue spots; fins all dusky and yellowish.

142. *DUYMÆRIA FLAGELLIFERA* (Cuvier and Valenciennes).

(*Ctenolabrus aurigaria* and *C. rubellio* Richardson).

One specimen, from Keerun.

This species is probably identical with the Japanese species, *Duymeria flagellifera* Cuvier and Valenciennes, of which *Duymeria japonica* Bleeker is a synonym. The equally common Japanese form, *Duymeria spilogaster* Bleeker, is the female of *D. flagellifera*.

143. *ANAMPSES CÆRULEOPUNCTATUS* (Rüppell).

One fine specimen, No. 343, from Formosa, F. I.

144. *HEMIPTERONOTUS VERRENS* Jordan and Evermann, new species.

One specimen from Keerun, distinguished by the very long ventrals.

Head 3.5; depth 2.9; eye 4.3; snout 2.4; interorbital 2 in snout; D. II-VIII, 12; A. III, 12; scales 3-29-7. Body short, deep, and very greatly compressed; head very short, the anterior profile nearly vertical; body highest at base of pectoral, thence tapering evenly on dorsal and ventral profiles to caudal; nape trenchant; eye high up; mouth small and low; teeth on jaws in a single close-set row, two outwardly directed strong canines in front in each jaw. Scales very thin; cheek with smaller scales; rest of head naked; lateral line running high, until near end of soft dorsal, where it drops 3 scales. Dorsal fin beginning on nape above posterior edge of orbit, the first 2 spines

detached and somewhat longer; anal beginning under first soft dorsal ray; caudal somewhat pointed or rounded; pectoral long and slightly falcate; ventral with the outer ray produced, reaching past front of anal.

Color in alcohol, pale yellowish, somewhat rosy on opercle; posterior part of side with indications of indistinct longitudinal lines; doubtless red in life.

Type.—A specimen 4.5 inches long, No. 7134, Stanford University Museum.

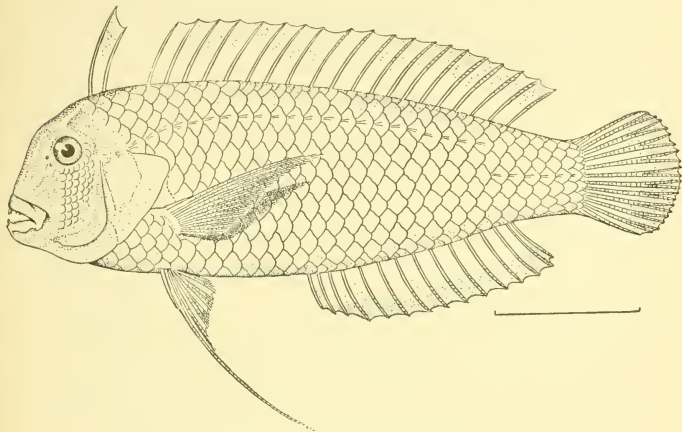


FIG. 22.—HEMIPTERONOTUS VERRENS.

145. *GUNTHERIA CENTIQUADRA* (Lacépède).

(*Julis hortulanus* Cuvier and Valenciennes.)

Coloration as described by Dr. Günther, except that no dark spots appear at base of caudal above; caudal and anal nearly plain. Canines $\frac{2}{3}$, the pair of small teeth next them somewhat enlarged; posterior canine inconspicuous, much smaller than figured in *G. centiquadra*. It is probably, however, not a distinct species. One specimen from Kotosho.

The genus *Guntheria* (including *Hemitautoga*) may be retained for those species of *Halichares* which have the upper part of the cheek covered with small scales, the cheek in *Halichares* being naked.

146. *CHEILO INERMIS* (Forskål).

One specimen, No. 11434, from Formosa, F. I.

Family SCARIDÆ.

147. SCARUS LACERTA (Cuvier and Valenciennes).

(*Scarus æruginosus* Bleeker, Günther, Day; probably not of Cuvier and Valenciennes.)

A fine specimen, No. 37 x, Formosa, F. I.

No posterior canine; upper lip covering more than half of upper jaw; two rows of scales on cheek, with one or two below on opercular limb; caudal short, lunate; three pale streaks on side of belly; dorsal edged with dusky; caudal rather dark, the color otherwise lost.

The species called *Scarus æruginosus* from the Red Sea, uniform green, with green jaws, is apparently some other fish. In any case the name *Scarus lacerta* has priority.

Family ILARCHIDÆ.

148. ILARCHES ORBIS (Bloch).

One specimen, No. 351, Formosa, F. I.

Family EPHIPPIDÆ.

149. EPHIPPUS ARGUS¹ (Gmelin).

One specimen, No. 5073, from Suwata.

One specimen, No. 309, from Giran.

Family PLATACIDÆ.

150. PLATAX TEIRA (Forskål).

One specimen, No. 298, from Hokoto, agreeing with a Japanese specimen from the coast of Rikuzen.

D. V, 33; scales 60.

One specimen, No. 341, Formosa, F. I.

Family CHÆTODONTIDÆ.

151. CHÆTODON PRÆTEXTATUS Cantor.

(? *Chatodon reticulatus* Cuvier and Valenciennes.)

(*Chatodon collaris* Bleeker; not of Bloch.)

Two specimens, Nos. 12 x and 296, Formosa, F. I.

A specimen, No. 365, from Formosa, F. I.

These differ from a Japanese specimen (from Satsuma) of *Chætodon collaris* Bloch (= *Chætodon aureus* Schlegel = *Chætodon auripes* Jordan and Snyder), in not having any of the dark streaks branched or forked

¹This species is the original type of Cuvier's genus *Ephippus*. *Ephippus* should replace *Scutophagus* and *Cacodoxus*.

behind, as is the case in the Japanese specimen and as figured by Schlegel (*Chaetodon aureus*). In the Japanese species the white band before the eye ceases at the level of the eyes, while in the Formosa species it extends above it. The Formosan specimens belong to *Chaetodon collaris* Bleeker, not Bloch, but we are not quite sure of their identity with *C. reticulatus*.

152. CHÆTODON FASCIATUS Forskål.

(*Chaetodon lunula* Lacépède.)

One specimen from Kotosho identical with others from Honolulu.

153. CHÆTODON LINEOLATUS Cuvier and Valenciennes.

Nos. 299 and 301, from Hokoto (Pescadores Islands).

Chaetodon semilarvatus, described as having 12 vertical cross-streaks of orange, can not be this species, as this one has about 16 cross-streaks.

154. CHÆTODON CITRINELLUS Cuvier and Valenciennes.

D. XIV, 21; A. III, 16; scales 36.

Dark spots along the rows of scales very distinct, as is also the yellow stripe above the broad black edge of the anal; dorsal with a very narrow dark edge. This species is wrongly identified by Bleeker with *Chaetodon miliaris*.

One specimen from Kotosho.

155. MICROCANTHUS STRIGATUS (Cuvier and Valenciennes).

One specimen, No. 311, of this common Japanese species.

Family ACANTHURIDÆ.

156. TEUTHIS TRIOSTEGUS (Linnæus).

One specimen, No. 326, from Kotosho.

Belly abruptly white, below a wavy bounding line; two black spots at base of caudal, one at upper, the other at lower edge; a black bar below eye; four black bars below dorsal fin; four black spots about base of pectoral; lips black.

This species, which is probably the original *triostragus*, differs from the species called by that name in Hawaii and on the off-shore islands of Mexico. The latter is *Teuthis sandwichensis* (Streets), its earlier synonymy, if any exists, being confused with that of *T. triostragus*.

157. TEUTHIS DUSSUMIERI (Cuvier and Valenciennes).

A large specimen, No. 335, Formosa, F. I.

D. IX, 26. Dark spots on caudal very distinct; traces of narrow wavy blue stripes on head, and faint traces of the same on body; a pale area about eyes; fins obscurely marked.

One specimen, No. 300, from Hokoto.

Allied to *Teuthis argenteus* (= *matoides*) and related species, but distinguished by the spotted caudal fin.

158. *TEUTHIS BIPUNCTATUS* (Günther).

(*Acanthurus nigros* Günther; not *A. nigroris* Cuvier and Valenciennes.)

Two specimens, No. 322, from Kotosho.

The synonymy of this species is rather uncertain. Our specimens are characterized by the plain dark-brown coloration, with ink-like spots in axil of dorsal and anal; lips black. Caudal deeply lunate, the upper lobe the longer. D. IX, 25; depth 2.17 in length.

159. *TEUTHIS OLIVACEUS* Solander.

A fine specimen, 13 inches long, No. 362, from Formosa, F. I.

This species is apparently the original *Teuthis olivaceus*, although different from the Polynesian species called by that name. D. IX, 24. Caudal lobes greatly produced. Orange band on shoulder extending to end of pectoral.

Head 4; depth 2.2; eye 4.75; snout 1.3; interorbital 2.75; D. IX, 24; longest dorsal spine 2.5, ray 1.6; A. probably about III, 27, the fin broken and hard to count accurately; ventrals 1.3; pectoral 1.2:

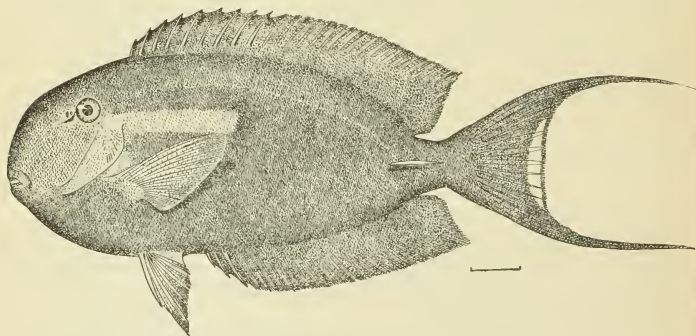


FIG. 23.—*TEUTHIS OLIVACEUS*.

scales about 140. Body oblong, compressed; dorsal and ventral outlines similarly arched; profile of head strongly arched, the outline almost vertical anteriorly; head rather short, the snout blunt; mouth very small, jaws equal; teeth broad, flat incisors, the tips and sides strongly denticulate; preopercular margin very oblique; branchiostegal membranes forming a fold across chin; eye small; nostrils close together in front of eye, the anterior somewhat the larger; caudal spine strong, somewhat keeled. Scales very small, strongly ctenoid,

densely covering entire body and head; a few scales on soft dorsal and anal; caudal fin densely scaled; dorsal fin beginning on nape just back of eye, the spines somewhat depressible in a groove, the last soft rays produced; anal similar to soft dorsal but the base longer; caudal lunate, the upper and lower lobes greatly produced; ventrals rather short, reaching origin of anal; pectoral short and broad, somewhat falcate.

Color in alcohol, dark brown, almost black; a long creamy white blotch on side from upper end of opercle to vertical at tip of pectoral, this bounded by jet black; fins all blue-black, except caudal which has a broad, subterminal, white bar on the middle rays, a narrow black border on tips of rays; pectoral black, the outer fifth yellowish white.

Family SIGANIDÆ.

160. SIGANUS VERMICULATUS (Kuhl and Van Hasselt).

One specimen, No. 5074, from Suwata.

Similar to *Siganus vermiculatus*, but with the body much more elongate; depth 2.5 in length, without caudal. This difference is perhaps due to the immaturity of the specimen.

161. SIGANUS FUSCESCENS (Houttuyn).

(*Siganus albopunctatus* (Schlegel).)

One specimen, No. 290, from Formosa, F. I. It is covered with small rounded bluish white spots, as usual in Japanese examples.

Two large specimens from Keerun; one specimen, No. 14x, from Formosa, F. I.

Family MONACANTHIDÆ.

162. STEPHANOLEPIS SULCATUS (Hollard).

One small specimen, No. 276, from Keerun.

Depth about half length; dorsal spine 1.7 in head; anal rays 32. Body covered with fine longitudinal striæ, the raised keels of the rows of scales.

Family TETRAODONTIDÆ.

163. SPHEROIDES OCELLATUS (Osbeck).

One specimen, No. 330, from Hokoto.

Dark blotches behind pectorals forming a bar across the back.

164. SPHEROIDES SCELERATUS (Forster).

One specimen, No. 283, from Hokoto, agreeing with the description given by Günther (VIII, 276). The back is dark brown, covered with darker spots of various sizes; the sides very abruptly silvery.

Family DIODONTIDÆ.

165. *DIODON HOLACANTHUS* Linnæus.

One specimen from Hokoto, No. 277, similar to Japanese examples.

Family SILLAGINIDÆ.

166. *SILLAGO SIHAMA* (Forskål).

One specimen. No. 292, from Formosa, F. I.

167. *SILLAGO ÆOLUS* Jordan and Evermann, new species.

Head 3.4; depth 5.6; eye 3.6; snout 2.5; interorbital 5.5; D. XI-I, 19; A. II, 17; scales 5-76-8. Body long, slender, and compressed; anterior profile gently arched from tip of snout to origin of spinous dorsal; ventral outline nearly straight; head long, the snout pointed; mouth small, low, somewhat oblique, the lower jaw included; teeth in

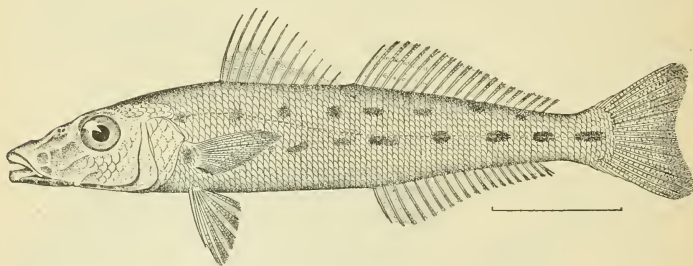


FIG. 24.—*SILLAGO ÆOLUS*.

broad villiform bands on each jaw and on vomer; head very rugose, the muciferous structure strongly marked; eye large, lateral; snout long and pointed; caudal peduncle moderate, compressed, its least depth a little more than one-half snout. Scales rather thin, somewhat irregular, weakly ctenoid; lateral line complete, slightly arched above the pectoral; nape scaled, head naked, except on cheek, where there are about two rows of large scales. Dorsal fins two, the first of long, slender spines, its origin above middle of pectoral; interspace between fins short; anal similar to soft dorsal, its origin somewhat more posterior; pectoral and ventrals moderate; caudal slightly forked.

Color in alcohol, pale straw-color; middle of side with two series of large, oblong, blackish blotches, about six or seven in each series; a plumbeous silvery band along middle of side below lateral line, most distinct posteriorly; fins all somewhat punctulate.

Type.—A specimen 5.25 inches long from Keerun, Formosa, No. 7135, Stanford University Museum.

Family LATILIDÆ.

168. *LATILUS JAPONICUS* (Houttuyn).

(*Latilus sinensis* (Lacépède); *Latilus argentatus* Cuvier and Valenciennes.)

One specimen, No. 30x, from Formosa, F. I.; one specimen, No. 368, from Formosa, F. I.; one specimen, No. 5070, from Giran.

Family PLATYCEPHALIDÆ.

169. *PLATYCEPHALUS INERMIS* (Houttuyn).

(*Platycephalus crocodilus* Tilesius; *Platycephalus guttatus* Schlegel.)

One specimen from Keerun, apparently identical with others from Hiroshima.

170. *PLATYCEPHALUS INDICUS* (Linnæus).

(*Platycephalus insidiator* Forskål.)

One large specimen, No. 342, from Formosa, F. I. One large specimen, No. 31 x=361, from Formosa, F. I.

Family TRIGLIDÆ.

171. *LEPIDOTRIGLA ALATA* (Houttuyn).

(*Lepidotrigla bürgeri* Schlegel.)

One fine specimen, No. 288, from Hokoto (Pescadore Islands).

Family CEPHALACANTHIDÆ.

172. *CEPHALACANTHUS JAPONICUS* (Bleeker).

One small example, No. 289, from Giran, apparently similar to the Japanese species, the proper name of which is still uncertain.

Family GOBIIDÆ.

173. *ELEOTRIS FUSCA* (Schneider).

One specimen, No. 5076, from Suwata. Scales about 55. Otherwise essentially like Hawaiian specimens. A comparison of many specimens will be necessary to show the value of this character.

174. *GLOSSOGOBIUS BRUNNEUS* (Schlegel).

One specimen from Kotosho, apparently exactly like others from Nagasaki; the characteristic cross-lines of dark spots at the nape present.

One very large specimen from Keerun.

The types of *Glossogobius* Gill, from Hongkong, referred to *Gobius platycephalus*, must have belonged to this species, having the peculiar notched tongue.

175. CTENOGOBIOUS PLATYCEPHALUS (Richardson).

Five specimens from Kotosho; one from Taihoku; one larger one, No. 348, from Formosa, F. I.

This species much resembles *Ctenogobius giuris*, but the scales before the dorsal are much larger. It is allied to *Glossogobius brunneus*, but differs in the characters called generic in *Glossogobius*, having the tongue not emarginate, and the isthmus broad. The name *Glossogobius* refers to the emarginate tongue.

We identify our specimens with Richardson's description of *Gobius platycephalus* with some doubt, as the original account is very incomplete. So far as it goes, however, it agrees with our specimens. Richardson's type came from Macao

Family BLENNIIDÆ.

176. SALARIAS NAMIYEI¹ Jordan and Evermann, new species.

Head 4.5; depth 4.5; eye 2.75; D. XXXII; A. XXIII; P. 13; V. 2. Body short and compressed; head short and very blunt, the profile from upper lip to top of eye vertical; mouth rather large, low,

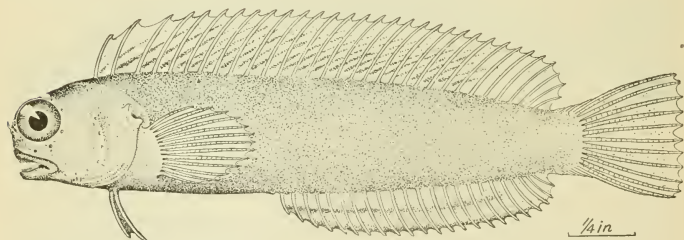


FIG. 25.—SALARIAS NAMIYEI.

nearly horizontal, the lower jaw somewhat the shorter; teeth in a very fine comb-like band on each jaw; eye large, high up, entering the profile; caudal peduncle deep and very thin. Body entirely naked. Dorsal fin very long, beginning on nape, composed entirely of soft flexible spines; anal similar, but beginning under about the thirteenth dorsal spine, the two fins coterminous; caudal truncate; pectoral broad and rounded; ventral of two slender rays and a concealed spine; a pair of short tentacles in front of eye.

¹ Named for Motokiche Namiye, curator in the Museum of the University of Tokyo, author of the earliest systematic account by a native author of the vertebrate animals of Japan. It is entitled Classified Catalogue of the Specimens of Vertebrates in the Collections of the Kyoiku Hakubutsu Kwan (Educational Museum), Tokyo, 1881.

Color in alcohol, purplish red, paler posteriorly; dorsal fin with narrow oblique darker markings; anal darker along the margin, and with a similar median band.

No canines; no tentacles; dorsal not notched, not connected with the caudal; no sharp color markings.

Type.—No. 278, specimen 2.5 inches long from Hokoto, or Pescadores Islands; returned to the Imperial University of Tokyo.

Family CEPOLIDÆ.

177. ACANTHOCEPOLA MESOPRION Bleeker.

No. 5063, a specimen 13 inches long from Giran.

Head 12; depth 13; eye 2.75; snout 5.5; interorbital 4.5; maxillary 2; mandible 1.8; D. 104; A. 105; pectoral 1.75; ventral 2; scales about 300.

Body very long, slender, very greatly compressed, tapering gradually from the head, where it is deepest, to the very slender tail, the

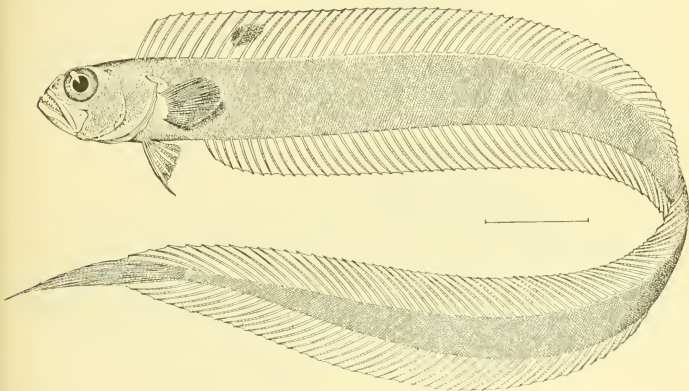


FIG. 26.—ACANTHOCEPOLA MESOPRION.

shape resembling that of the scabbard-fish (*Trichiurus lepturus*); eye very large, high up, entering the dorsal profile; snout very short; mouth very large, nearly vertical; maxillary broad at tip, reaching past pupil; teeth in a single wide-set row in each jaw, long, recurved, and canine-like; opercle and preopercle very deep, the latter with about 6 short sharp teeth at the angle; scales very small and smooth, covering sides of head and entire body; top of head, maxillary, and lower jaw naked; no lateral line. Dorsal and anal fins very long, each of about 105 soft rays; the dorsal beginning at nape, the third ray over opercular opening, the rays all of about equal length, about 1.75 in head; anal beginning under last third of pectoral, continuous with the caudal, as is the dorsal, the rays quite uniform in length, the longest

about 1.75 in head; caudal with about 9 rays, the middle ones very long, nearly twice length of head; pectoral short and broad, ventral I, 4, short, the spine long and slender, 3 in head; vent under nearly middle of pectoral.

Color in alcohol, dirty silvery, the head and body without markings; fins all plain except a large black blotch on membrane between the eighth and eleventh dorsal rays; other fins unmarked.

Dorsal with a large black spot in front; anal with a brown margin; scales extremely small; proopercle with 7 or 8 spinous teeth.

This species is certainly different from the Japanese *Acanthocephala krusensterni*, having minute scales, doubtless over 300 in the lateral line, and a more elongate body. It may be identical with the scantily described *Cepola limbata* or *Cepola marginata* of Cuvier and Valenciennes.

Family BROTULIDÆ.

178. BROTULA FORMOSÆ Jordan and Evermann, new species.

Head 5; depth 4.5; D. 115; caudal 8; A. 83; P. 24; V. 2; about 158 scales in a lateral series between gill-opening and base of caudal; width of head 2 in its length; snout 4.5 in head; eye 4.7; interorbital space 6; maxillary 2 in head; pectoral a little over 2 in head; ventrals about equal to pectoral.

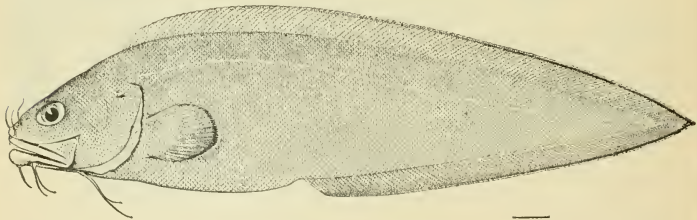


FIG. 27.—BROTULA FORMOSÆ.

Body elongate, compressed, and the tail tapering to a point; head oblong, compressed; snout blunt, rounded, and rather short; eye rather small, anterior and superior; mouth large, the maxillary reaching far behind the eye, and the distal expanded extremity of maxillary about equal to the diameter of the eye; 6 superior barbels, as 2 nasals and 4 labials, and 6 inferior barbels, 3 on each ramus; lips thick and tough; teeth in jaws, on vomer and palatines, in broad, villose bands; nostrils in 2 small tubes, separated by a little space, and upon the sides of the snout; 2 very short rudimentary barbels between each pair of upper labial barbels; interorbital space about $\frac{3}{4}$ the eye, and convex; maxillary fitting under suborbital flap for nearly its whole distance; opercles with a spine above; tongue pointed, smooth, and free in front;

gill-opening large, the branchiostegal membrane narrowly free over the isthmus; gillrakers $4 + 18$, 3 of which are developed on the upper part of the ceratobranchial, all the others very short, rounded, and finely villous; pseudobranchiæ well developed; branchiostegals rather large, 8 in number; intestine short, of several turns; pyloric cæca 3, short; peritoneum pale or silvery. Scales small, thin, elongate and cycloid, very small upon the vertical fins, and upon the pectoral, the latter completely covered. Origin of the dorsal before that of the pectoral, the fin of uniform height and confluent with the caudal, which is pointed; origin of the anal much nearer the tip of the snout than base of caudal and similar to dorsal; pectorals broad, rounded, and a little less than halfway to origin of anal; ventrals of two filaments, one much longer than the other and ensheathed in a membrane for half the length of the longer; ventrals inserted slightly nearer posterior margin of eye than edge of opercle; lateral line superior and not particularly distinct.

Color in alcohol, more or less uniform brown, the edges of the vertical fins and pectorals blackish. Length 19 inches.

This description from a female from Formosa, No. 359, F. I., returned to the Imperial Fisheries Institute.

Family PLEURONECTIDÆ.

179. PSEUDORHOMBUS OLIGODON (Bleeker).

This species differs from *Paralichthys arsius* (= *P. russelli*) in having the scales on the blind side ctenoid, like those on the left side.

The genus *Pseudorhombus* (*malayanus*; *russelli*) may be recognized as distinct from *Paralichthys*, being characterized by the presence of an accessory branch to the lateral line running from the upper edge of the gill-opening to the nape. The American species and the Japanese species *olivaceus* belong to *Paralichthys*. The East Indian species all seem to belong to *Pseudorhombus*.

The species of this type, described by Richardson¹ from drawings made at Canton, are probably unrecognizable from the descriptions.

One specimen, No. 350, Formosa, F. I.

One specimen, No. 42 x, Formosa, F. I. Gillrakers short, $x + 11$, about one-third diameter of eye. A. 57; scales 78. A dark blotch at angle of lateral line, and another behind; body and fins with dark blotches.

180. PLATOPHRYS MYRIASTER (Schlegel).

One specimen from Keerun. A. 69; scales about 115. Surface covered with small blue spots; two dark spots on lateral line.

Two specimens, Nos. 41 x and 47 x, from Formosa, F. I.

¹ Ichth. China, p. 278.

Family SOLEIDÆ.

181. LIACHIRUS NITIDUS Günther.

A fine specimen, 4 inches long (No. 287), from Giran, agreeing with Günther's description.

Head 4.5; depth 2.5; snout 3.2; D. 63; A. 48; V. 5; scales about 25-92-35, small and hard to count. Body dextral, the color and eyes being on the right side; body oblong elliptical; snout bluntly rounded; mouth rather large, the gape reaching eyes; eyes close together, small; scales very small, smooth, and rather loosely attached; lateral line extending from near upper eye nearly straight to middle of caudal; dorsal and anal fins rather high, about 1.8 in head.

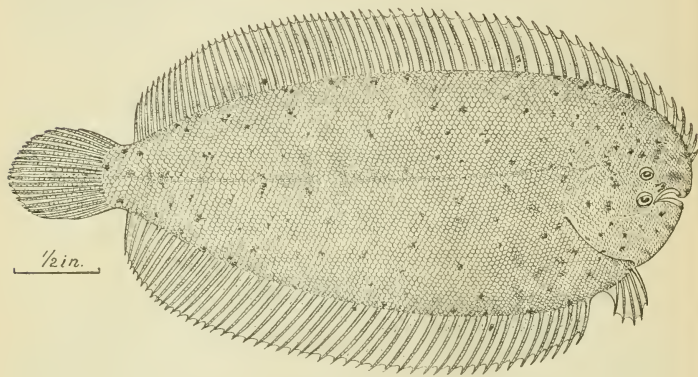


FIG. 28.—LIACHIRUS NITIDUS.

Color in alcohol, yellowish-gray, the body and head sparsely covered with small, roundish, black spots, a few of these upon dorsal and anal fins; dorsal and anal rays dark edged; caudal with a few dark specks.

182. SYNAPTURA ORIENTALIS (Schneider).

(*Synaptura foliacea* Richardson.)

One specimen, No. 369, from Formosa, F. I.

The nostrils in this species are similar to those of *Synaptura pan.* The genus *Euryglossa*, based on their supposed peculiarities, is without foundation.

183. USINOSITA JAPONICA (Schlegel).

One small example from Keerun, similar to examples from Kobe.

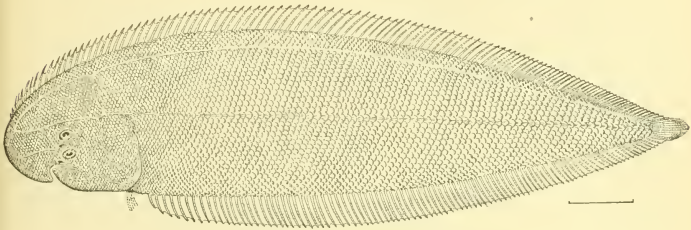
184. PARAPLAGUSIA BILINEATA (Bloch).

One specimen, No. 45x, from Formosa, F. I.; one specimen from Keerun.

185. *CYNOGLOSSUS DIPLASIOS* Jordan and Evermann, new species.

One large specimen (No. 43) 10.5 inches long, from Formosa, F. I., returned to the Imperial Fisheries Institute. This species is well distinguished by the presence of two complete and well developed lateral lines on either side.

Head 5 in total length; depth 4; eye 10; snout 2.6; D. 112; A. 95; scales about 100,—40; scales on upper part of head and along base of dorsal fin very strongly ctenoid, elsewhere scarcely or not at all ctenoid; scales on head very much reduced in size; mouth large, fully protected by the upper lip. Body sinistral, that is, the eyes and color

FIG. 29.—*CYNOGLOSSUS DIPLASIOS*.

on the left side; scales of blind side more smooth than elsewhere; nostril small, tubular, close to eyes; upper eye slightly in advance of lower, equal in size; dorsal beginning on snout in front of eyes; pectorals obsolete.

Color in alcohol, pale dirty-yellowish, the head somewhat darker; no distinct markings anywhere.

186. *ZEBRIAS ZEBRA* (Bloch).

One specimen, No. 44x, from Formosa, F. I., corresponding to Günther's description. D. 80. The figure given by Day¹ seems to represent some other fish, with the cross-bands not in pairs, and with fewer fin rays.

GENERALIZATIONS.

It is evident that these collections comprise but a small part of the fish fauna of Formosa, being in fact chiefly made up of the common market fishes. The gobies and blennies, especially abundant in this region, are almost unrepresented, while the equally abundant *Callionymidae* are wanting altogether. The scant representation of *Labridae*, *Holocentridae* and *Scorpenidae* shows that no effort was made to secure the fishes of the coral reefs, and doubtless many of the commonest species were overlooked or rejected by the collectors. Yet with all

¹Fishes of India, pl. xciv, fig. 3.

this, the collections give a fair understanding of the fishes of Formosa. It is evident in the first place that the marine species are essentially those of that part of the coast of China having similar physical conditions. The freshwater fishes are derived from China, but are largely distinct as to species.

Compared with Japan and India, the following statistics may be interesting:

	Species.
Common to Formosa and Kiusiu	30
Common to Formosa and Hindostan.....	77
Common to Formosa, Kiusiu, and Hindostan	37

It is evident that the faunal relations of Formosa are closer with those of Hindostan than with even the southernmost of the Japanese islands, Kiusiu. As for the main island of Japan (Hondo), few of its characteristic species extend their range south of the Tropic of Cancer; and few of them reach even to the Riukiu Archipelago.

DESCRIPTIONS OF THE LARVÆ OF SOME MOTHS FROM COLORADO.

By HARRISON G. DYAR,
Custodian of Lepidoptera.

With the sanction of the Secretary of the Smithsonian Institution, I spent three months in Colorado in the summer of 1901, to investigate the life histories of some of the moths of that region. As Colorado embraces several different faunal regions, and as the arid condition of the country renders the fauna very sparse and sporadic, different conditions are found to obtain there than in the Atlantic region in the matter of collecting. It was found impossible to move about so as to cover various faunal regions without losing the larvæ already collected in one place, owing to the impracticability of keeping a fresh supply of food plants. I located in Denver and collected mainly on the prairies and foothills within 20 miles of that place. Mr. A. N. Caudell, of the Department of Agriculture, accompanied me, and was allowed to assist me by the permission of the entomologist of that Department.

The species of Lepidoptera occurring in Colorado indicate four faunal regions in the State. (1) The prairie fauna occupies all the flat land from the bases of the foothills eastward, probably including the eastern third of the State and reaching to Texas. It is composed largely of species peculiar to the region. The very dry condition of this land and the sparse vegetation, mostly disappearing early in the season, with the absence of trees, renders this condition necessary. (2) The fauna of the foothills occupies the hilly and uneven land from the bases of the mountains up to timber line. The line of division between this fauna and that of the prairie is very marked. The foothills rise quite sharply from the plains, and within a few paces, almost, the change in the fauna is observable. The foothills have a few trees, pine, and other evergreens, with a dwarf oak, all sparsely distributed; a hardy bush, *Cercocarpus parvifolius*, seems to prefer the most unfavorable hill tops. In the bottoms of the canyons, where water persists, cottonwood, willow, and other trees occur, often densely, which permits the occurrence of many species belonging to the Atlantic region

that are absent from the other faunal regions of Colorado. I did not notice any essential change in the fauna with altitude, from the base of the foothills (5,000 feet) to timber line (12,000 feet). Naturally the individuals were later to emerge in the higher altitudes, but on the whole they were the same species. (3) The Alpine fauna occurs on the high peaks above timber line. It is a small fauna, but entirely distinct from the others. It is essentially that of all mountain peaks, being comparable with the mountain summits of New Hampshire and with Labrador. (4) The fauna of western Colorado occupies the valleys west of the continental divide and doubtless extends to the Sierra Nevada of California and to Mexico. It was impossible to obtain any larvæ from this region, much to my regret. Efforts were made to do so, but proved ineffectual without sacrificing the larvæ that had been collected in the eastern foothills. It is of these latter, with a few from the prairie region, that I have made note.

The following is only a partial list of species observed. Those of which the larvæ did not come under observation, even though the moths were collected, are not mentioned. Besides the 69 species here noted, I have given full life histories of 10 species of Geometridæ in "Psyche," descriptions of the larvæ of 3 species of *Depressaria* in Mr. Aug. Busck's paper on that genus, 5 species of *Gelechia* in Mr. Busck's article on the Gelechiidæ, and of *Triprocris smithsonianus* in the Proceedings of the Entomological Society of Washington. A number of species were noted but not bred, and there remain several not yet satisfactorily determined, to which I shall revert when the opportunity offers.

LIST OF SPECIES.

- | | |
|---|--|
| <i>Hemileuca maia</i> Drury. | <i>Syueda hastingsii</i> Henry Edwards. |
| <i>Hemileuca nevadensis</i> Stretch. | <i>Alypia maccullochii</i> Kirby. |
| <i>Pseudohazis shastacensis</i> Behrens. | <i>Malacosoma tigris</i> Dyar. |
| <i>Apantesis superba</i> Stretch. | <i>Eudule unicolor</i> Robinson. |
| <i>Apantesis figurata</i> Drury. | <i>Hydriomene trifasciata</i> Borkhausen. |
| <i>Leptarctia californiæ</i> Walker. | <i>Sciagraphia perrolata</i> Hulst. |
| <i>Leucarctia aerea</i> Drury. | <i>Diastictis occiduaria</i> Packard. |
| <i>Eubaphe aurantiaca</i> Huebner. | <i>Aleis haydenati</i> Packard. |
| <i>Halisidota maculata</i> Harris. | <i>Enemera jturnaria</i> Guenée. |
| var. <i>alni</i> Henry Edwards. | <i>Epiplatymetra coloradaria</i> Grote and Robinson. |
| <i>Heliothis phlogophagus</i> Grote and Robinson. | <i>Odontotia elegans</i> Strecker. |
| <i>Caradrina extimia</i> Walker. | <i>Pheosia dimidiata</i> Herrich-Schaeffer. |
| <i>Leucania fureta</i> Grote. | <i>Tortricidia testacea</i> Packard. |
| <i>Stretchia plusiformis</i> Henry Edwards. | var. <i>crypta</i> Dyar. |
| <i>Xylina torrida</i> Smith. | <i>Melitara junctolineella</i> Hulst. |
| <i>Xylomiges simplex</i> Walker. | <i>Acrobasis betulella</i> Hulst. |
| <i>Thyreion rosea</i> Smith. | <i>Pionea belialis</i> Druce. |
| <i>Cucullia laticfa</i> Lintner. | <i>Oxyptilus delawarensis</i> Zeller. |
| <i>Ipimorpha pleonectusa</i> Grote. | <i>Pterophorus sulphureodactylus</i> Packard. |
| <i>Cissura valens</i> Henry Edwards. | <i>Platyptilia cosmodactyla</i> Huebner. |
| <i>Syneda howlandii</i> Grote. | |

Alucita cinerascens Walsingham.
Teras foliana Walsingham.
Cacacia argyrosipila Walker.
 var. *viridana* Dyar.
Cacacia seniferana Walker.
Cacacia negundana Dyar.
Cacacia cerasiflorana Fitch.
Cacacia rosaceana Harris.
Lophoderus coloradana Fernald.
Cenopsis directana Walker.
Platynota labiosa Zeller.
Orchemia diana Huebner.
 var. *betuliperda* Dyar.
Cerostoma rubrella Dyar.
Gnorimoschema coquillettella Busck.
Anactamps innocella Zeller.

Nealyda bijidella Dietz.
Gelechia ribesella Chambers.
Gelechia unctella Zeller.
Gelechia pravinominella Chambers.
Gelechia anarsitella Chambers.
Gelechia versutella Zeller.
Gelechia ocellella Chambers.
Gracilaria pnosodiella Busck.
Gracilaria thermopsella Chambers.
Leucoptera albella Chambers.
Lithariapteryx abronivella Chambers.
Lithocolletis cincinnatiella Chambers.
Lithocolletis basistrigella Clemens.
Lithocolletis fitchella Clemens.
Lithocolletis salicifoliella Clemens.
Tisheria cinctipennis Clemens.

Family SATURNIIDÆ.

HEMILEUCA MAIA Drury.

Larva.—Head and feet dark mahogany red in the last stage, black before that; width 4.5 mm. Body black, thickly covered with secondary yellow dots centered by black hair tubercles; subdorsal, lateral, and waved substigmatal lines yellow, broken; incisures reddish. Spines all long, some setæ white; spiracles black, the elevated spots behind them on joints 5 and 11 reddish.

This larva is well known in the Atlantic coast region from Massachusetts to Florida and has been often described. The young larvæ were found gregariously on the oak on May 20, in a gulch leading up from the Platte Canyon. They were matured about the 1st of July. No moths were bred, but I can not doubt the identification, as the larva is very familiar to me.

HEMILEUCA NEVADENSIS Stretch.

Larva.—Head, plates, and feet very bright mahogany red; width 4.5 mm. Body with the yellow spots confluent all over the dorsal and lateral spaces, making the ground color yellow except narrowly subdorsally and ventrally. Spines of the upper row all bright brown, the long ones with black shafts.

This larva is well known in the Pacific coast region and through the arid West, and has been described in all its stages. Several were found on willow near Denver by a water course in the prairie, and were matured about the 1st of July. A moth emerged in September.

The occurrence of these two species within a few miles of each other, but in different faunal regions, is interesting, both as illustrating that they are different species though so similar, and how the Atlantic coast fauna is interpolated in the middle of the Western one along the foothills of the Rocky Mountains.

PSEUDOHAZIS SHASTAENSIS Behrens.

Larva.—Head high, tapering conically, clypeus low, sutures impressed, erect, free, shining black; width 4.5 mm. Body purplish black with faint traces of white lines, the subventral the most distinct; secondary hairs fine, pale, with imperceptible tubercles. Upper row of spines shortened on joints 5 to 12, most of the spinules buff yellow; some buff ones also on the not shortened upper spines of joint 4; other spines black; no white dots on the body.

The larvæ were found, gregarious when young, on rose and wild cherry on the foothills back of Golden. They were matured about the middle of July. *Pseudohazis* occurs all through the West, but there are three forms or species. The one occurring on the eastern foothills is the one with pink ground color in the fore wings that I call *shastaensis*, as proved by examples in Prof. C. P. Gillette's collection.

Family ARCTIIDÆ.

APANTESIS SUPERBA Stretch.

Larva.—Head shining black, labrum yellowish, antennæ pale, pinkish at base; width 3.3 mm. Body black, thoracic feet black, the abdominal ones pinkish, pale. Warts large, normal, arctiidiform, i and ii with shining bases, i over half as large as ii, which is elongate. Hair abundant, bristly, sparsely barbed, rather short before, long on joints 12 and 13; most of the hair from wart i and a few on the sides of ii are yellow, below this jet black mixed with white, mostly white from warts iv to vi. Warts iii orange, the rest black. A light yellow dorsal line, broken into three spots on each segment, distinct, most of them lanceolate; a line on joints 2 and 3, no shields; joint 2 with little warts, normal.

A variety had the dorsal line nearly obsolete, composed of a few dots; wart iii black like the others. Hairs nearly all yellow, only a few black ones mixed; some longer white ones posteriorly.

Found at Boulder and Golden in the foothills on the ground or feeding on low plants, *Astragalus* and *Lupinus*. The larvæ were very lively and would run for shelter when discovered. They became matured in June, apparently from hibernated larvæ. Moth, July 13. Though not uncommon they were hard to rear, and only one female was obtained. I think, however, that this is the larva of *A. incorrupta*, of which I have only males.

A parasite, *Tachina mella* Walker, was bred from one larva.

APANTESIS FIGURATA Drury.

Larva.—Head shining black, epistoma and bases of antennæ pale; width 2.7 mm. Body brown-black, the abdominal feet pale reddish. A broad, distinct, sharp dorsal line, narrowed between warts i, cream

white, pinkish shaded in the incisures. Warts black, hair bristly, sparsely barbuled; i small, less than one-third the size of ii, i with small, ii with large shining base, normal. Hair all black, even the sub-ventral, longer on joints 12 and 13.

One larva found by Mr. E. J. Oslar on the foothills, May 12; it fed on alfalfa. The moth that emerged was of the form *f. pallida* Strecker.

LEPTARCTIA CALIFORNIAE Walker.

Egg.—Low conoidal, practically two-thirds spherical, shining pearly flesh color; rather coarsely reticularly shagreened, almost definitely reticulate at the vertex, but the lines broad and confused; diameter 1 mm., height 0.7 mm.

Stage I.—Head bilobed, erect, shining black. Body translucent, faintly yellowish, warts and shields dark brown, thoracic feet black; slight reddish-brown shading about the warts. On thorax warts ia and ib united on a single large plate, single haired; iib small, shortly separated from iia; iv single, vi double, no subprimaries. On abdomen i small, ii on a large plate, iii with two hairs, iv and v single, iv well behind the spiracle, vi absent, but a small, elongate, hairless shield in its place; vii forming a well-developed shield on the leg. Cervical shield with four hairs on each side, three of them black; two other hairs detached on a tiny wart. Joint 13 anteriorly has one wart with four hairs and one with two. The rudimentary tubercle vi is present on joints 5 to 12. Hairs long and fine.

The remaining stages have been fully described by Prof. G. H. French.¹ He found five stages, which my observations do not contradict. Mr. Oslar secured me some eggs, and I obtained others from moths taken on the foothills behind Golden, and later I found some larvæ there on the ground or feeding on low plants. The species is not uncommon in the foothills and canyons; I remember it to have been abundant in Williams Canyon near Maniton in 1891.

LEUCARCTIA ACRAEA Drury.

This ubiquitous larva occurred on the prairie and on the foothills as high as Salida, where Mrs. A. N. Caudell collected one. The species seems to despise all natural boundaries and be at home in all four regions.

EUBAPHE AURANTIACA Huebner.

Eggs.—Rather low, roundedly conoidal, the base flat and slightly rimmed; shining pale yellow. Reticulations narrowly linear, irregularly hexagonal, not raised, faint. Diameter, 0.6 mm. Turned dull pink.

Stage I.—Head rounded, cordate, pale luteous, shining, broadly

¹Can. Ent., XXI, 1889, p. 210.

gray shaded over the vertex; eye black. Body normal, aretiiform, pale luteous, warts and shields smoky; hairs dark, long, especially long from joints 5, 6, and 12. Warts i conjoined on the dorsal line into a single pentagonal shield on joints 5 to 11, two separate, elongate, parallel shields on joint 12, single haired; ii single haired, produced forward and downward; iii to v single, normal; vi absent. On the thorax tubercles ia+ib, iia, and iib separate, iib posterior, iv large, vi moderate; no subprimaries. Warts of joint 13 consolidated. Hairs i to iii black, the rest white, spinulose. Cervical shield not converted into warts, divided, notched behind. Feet colorless, long and slender, especially the abdominal ones.

Stage II.—Head bilobed, shining dusky. Body greenish from the food, transparent, shining. Warts small with numerous stiff hairs; i rudimentary, hairless. Hairs dark, spinulose.

Stage III.—Head shining black, bilobed; width about 0.4 mm. Body shining dusky luteous, warts black; i small, paired. Hairs black, moderate, of various lengths, barbed.

Stages IV and V were not described; there was no marked change.

Stage VI.—Head bilobed, aretiiform, black; width 1.4 mm. Body brown, not dark, rather sordid and pale, the lighter-colored warts iii and v orange tinted; a straight dull-orange dorsal line. Warts black; hair black dorsally, pale subventrally, rather bristly, sparse, longer posteriorly. Warts well elevated, round, i small, iv absent, the rest large. All have black hairs at the summit, white ones at the base, but there are more black ones dorsally.

Cocoon a delicate web of silk. Moths emerged August 8, from eggs obtained from moths flying in the foothills June 27.

HALESIDOTA MACULATA Harris, variety ALNI Henry Edwards.

This species occurs in three forms in the United States. Those inhabiting the northern Atlantic region and the northern Pacific region, respectively, are indistinguishable in the moth state, though different as larvæ. I have several times received *H. maculata* from Colorado, but never knew to which race to refer the specimens. Mr. Caudell took a larva near Salida and Professor Gillette has in his collection some cast skins. Both show the red dorsal hairs of *alni*, proving the Coloradan form the same as the northern Pacific coast one.

Family NOCTUIDÆ.

HELIOTHIS PHLOGOPHAGUS Grote and Robinson.

Stage I.—Head round, bilobed, black, polished, the vertex under joint 2; epistoma and antennæ white; width about 1.6 mm. Body cylindrical, normal, joint 12 not enlarged but a little angled. Tubercles large, conic, polished black, prominent. Skin spinulose; setæ

large, pale, curved. Black with yellow dorsal line, fine, broken pulverulent; subdorsal line double, running along tubercles i and ii, similar, a little less broken; lateral line broader, broken on the annulet incisures; traces of a line along tubercle iii; stigmal band broad, including the spiracles and tubercle iv, sharp edged, luteous centered. Feet black. Shields uncornified concolorous, their tubercles black.

Stage VI.—Head green, brownish freckled on the vertex, ocelli black, epistoma whitish; width 2.7 mm. Body cylindrical, normal, shields not cornified. Skin white, granular, spinulose; tubercle iv at center of spiracle or above. Green, traces of a whitish dorsal and subdorsal line; stigmal band broad, whitish green, white edged below; dorsal line obscure, geminate, blackish filled. Tubercles raised, conic, small, black, white ringed. Feet equal, green. Subdorsal line cuts the cervical shield. Spiracles black rimmed, pale bordered.

Food plant *Grindelia squarrosa*. Found in the Platte Canyon May 30 and collected by Mr. E. J. Osler at Manitou.

CARADRINA EXTIMIA Walker.

Eggs.—Spheroidal, flattened at base, about 40-ribbed, the number diminishing toward the vertex; ribs sharp, narrow, the apices concave, with distinct, curved cross-striæ about as distinct as the lines on the ribs. Vertex hollowed reticulate; yellowish white, stained with an irregular brown ring; diameter, 0.6 mm.; height, 0.4 mm.

Stage I.—Head round, vertex under joint 2, sordid luteous, eye black; width, 0.3 mm. Body cylindrical, thick, joint 12 large dorsally; sordid whitish, the food faintly green; tubercles large, round, black, distinct, normal; ia to iib on the thorax separate, equal, iv on the abdomen behind the spiracle. Shields and leg plates blackish luteous, normal; setæ pale.

Stage II.—Head rounded, blackish; width, 0.5 mm. Body translucent, green from food; cervical shield, anal plate, and the rather large tubercles black. Traces of white dorsal and subdorsal lines; feet pale, those of joints 7 and 8 a little shorter than the others; shields blackish, setæ pale.

Stage III.—Head dark smoky brown, blackish over the lobes, round, scarcely bilobed, apex slightly under joint 2, but held erect; width, 0.9 mm. Body thick, robust, cylindrical, no enlargements. Dorsum gray brown to spiracles, faintly mottled in pale, forming traces of the usual lines. Below the spiracles sharply paler, slightly pinkish. Tubercles rounded, elevated, blackish, normal, iv at the top of the spiracle. Feet and leg shields smoky blackish. Setæ rather long, pale, curved.

Stage IV.—Head dark smoky brown, clypeus paler, sordid; held erect, slightly retracted; width, 1.2 mm. Body sordid brown, mot-

tled, subdorsal line diffuse above, obscurely pale. Color paling ventrally but not sharply. Tubercles black. Very obscurely colored and without defined marks.

Stage VI.—The same, pale, obscurely marked. Dorsal space broadly paler mottled, all sordid brown. I have previously described this stage.¹ Width of head 1.8 mm.

Eggs from a female moth taken at Denver, June 23. Moths issued from these larvæ August 13. The larvæ fed readily on *Polygonum*; probably they would eat any low plants.

LEUCANIA FARCTA Grote.

Eggs.—Spheroidal, distinctly flattened above and below, about alike at the ends, somewhat irregularly shaped from pressure as they were laid in a crevice, glued to both sides but weakly. Shining pale yellow. Reticulations finely linear on a smooth surface, irregularly 4 to 6 sided; no trace of ribs. Flattened sides smooth, somewhat plainly rimmed; diameter 0.6 mm.

Stage I.—Head round, luteous, ocelli large, black; width 0.3 mm. Body cylindrical, joint 12 enlarged dorsally, joints 5 and 6 enlarged; semilooping, but the feet of joints 7 and 8 only a little smaller than the others; segments rather roughly 3 to 4 annulate, especially on thorax. Whitish translucent; cervical shield small, brownish; food faintly yellowish, no marks. Tubercles and setæ obsolescent and scarcely visible. Thoracic feet brownish at tip; no leg shields nor anal plate; setæ pale.

Stage II.—Head rounded, slightly bilobed, erect, antennæ rather large; translucent testaceous, dark on the vertex from within, ocelli black, mouth brown; width 0.5 mm. Body cylindrical, rather larger behind the thorax and at joint 12. Dull gray-green dorsally, whitish ventrally with narrow whitish dorsal, subdorsal and lateral lines; the division between the dorsal and ventral colors is sharp. No shields; tubercles small, vi present. Feet pale, normal, practically equal.

Stage III.—Head rounded, bilobed, apex in joint 2; dull luteous; width 0.8 mm. Body smaller behind but subequal, scarcely any enlargements. Finely striped in brown and olivaceous yellowish. Ground pale olivaceous; dorsal line whitish, brown edged; subdorsal line whiter, brown edged, very distinctly so below; below this a yellowish white line; lateral line yellowish white, brown edged; stigmal band white, brown edged, heavily so above; three broken subventral lines; feet and venter pale, scarcely marked. No shields.

Stage IV.—Head held flatly but free from joint 2, luteous, brown reticulate; width 1.4 mm. Body striped in olivaceous yellow and brown. Geminate dorsal, addorsal, broad subgeminate subdorsal lines

¹ Proc. Ent. Soc. Wash., IV, 1899, p. 322.

brown; geminate lateral olivaceous filled; broad dark lower lateral and suprastigmatal; substigmatal broad, pale yellow, red filled, folded subventrally. Two weak lines subventrally and faint traces of ventral dark lines. Feet pale, dusky shaded, equal.

Stage V.—Head the same, the reticulations heaviest in a line each side of clypeus and in middle of lobe; width 2 mm. Lines as before, but the lateral is not discolorously filled; all lines red-brown except the broad lower lateral and suprastigmatal which are olivaceous brown.

Stage VI.—Head rounded, scarcely bilobed, erect, free; testaceous, shining, reticulate with dark brown, forming a narrow shaded band edging the paraclypeal pieces, divergent again at the vertex; a less distinct dark line up from the eye; clypeus and median suture broadly pale; tubercles brown; width 3.2 mm. Body cylindrical, normal, not tapering, no enlargements; feet normal, equal. Testaceous, finely strigose lined in red-brown. Dorsal line narrow, pale; a faint, similar line between tubercles i and ii; subdorsal band broad, gray-brown strigose, pale edged above and below, straight; space below red-brown, strigose. Lateral and stigmatal bands broad, gray-brown strigose, contiguous, separated only by the narrow pale edging, the lateral band also edged above in pale, the stigmatal below, this edge being the upper border of the substigmatal band, which is broad, straight, red-brown strigose filled, except at its pale edges. Venter, mottled strigose. Shields undeveloped, concolorous. Tubercles small, black; iv at the upper corner of the spiracle. Spiracles black. Thoracic feet pale, brown tipped; abdominal ones of joints 7 to 10 with smoky blackish shields, excavate above; anal feet reticularly lined.

The moth approaches closely to *L. juncicola* Boisduval and *L. multilinea* Walker, but I have the larvæ of neither to compare. From *L. phragmatidicola* they differ in the color being lighter throughout, the ground testaceous rather than pale brown; the markings are identical in both.

STRETCHIA PLUSIFORMIS Henry Edwards.

Eggs.—Ellipsoidal, scarcely more flat at base than at vertex; neatly 30-ribbed, diminishing by a few toward vertex, the ribs gently waved; cross-striæ fine, indistinctly seen on the sloping sides of the ribs, the vertical reticulation lines on the summits of the ribs not more distinct than the cross-striæ. Micropylar area broadly smooth, finely reticulate. The sculpture reaches a little beyond the lower third of the egg, which is perfectly smooth and shining. Diameter 0.9 mm., height 0.6 mm. Later there appeared a red ring and spot at the summit.

Stage I.—Head rounded, faintly bilobed, full, broad, pale luteous with black ocelli, erect; clypeus narrow, sutures grooved; width about 0.4 mm. Body slender, submoniliform, flattened; feet normal, the two anterior abdominal pair somewhat shortened; joint 12 slightly enlarged. Whitish colorless, translucent, the alimentary canal appear-

ing sordid reddish; shields concolorous, pale luteous, not large. Tubercles small, black, distinct, normal; setae short, pale; feet colorless. The larvæ were quiet and sluggish, remaining hidden all day.

Stage II.—Head rounded, slightly bilobed, larger than joint 2, the lobes full; held obliquely; pale luteous with minute brown dots on the tubercles and a patch on each side of the median suture; antennæ and labrum partly pale; width 0.6 mm. Body cylindrical, normal, joint 12 slightly enlarged; feet normal, but those of joints 7 and 8 slightly reduced. Sordid whitish, shields concolorous, scarcely cornified; narrow white dorsal and subdorsal lines, a broader stigmatal one, irregular and blotched. Tubercles neatly black; feet pale; setae moderate.

Stage III.—Head rounded, polished orange, the clypeus and sutures more yellowish, mouth brown, ocelli black; width 1 mm. Body cylindrical, noctuiform, joint 12 enlarged, joints 3 to 6 arched in rest. Green, sordid, subtranslucent; neat, narrow, white dorsal and subdorsal lines; a broad white substigmatal band inclosing tubercles iv and v and the spiracle. Feet normal, equal. Tubercles neat, round, moderate, with the spiracles black, the latter narrowly ringed. Shields concolorous, the cervical shield polished. Feet all pale, the abdominal ones with the tubercles vii black. A brown form of the larva also occurred. All shaded with dilute black between the lines; stigmatal band slightly yellowish; feet pale but sordid tinted; head as in the green form.

Stage IV.—Head rounded, the vertex slightly under joint 2, shining brown, mottled with darker; width 1.5 mm. Body thickly mottled with chocolate brown on a whitish ground, the dorsal space lighter by the ground showing more distinctly. Fine dorsal and subdorsal white lines somewhat dotted and broken; stigmatal line broad, sharply edged, narrowed in the incisures, white edged, broadly dull red and luteous filled, including tubercles iv and v and the spiracles which are white, narrowly black rimmed. Tubercle iv at center of spiracle, or above on joints 9 and 10. Venter paler; feet pale; tubercles in rather large black spots. Shields concolorous.

Stage V. (Interpolated).—One larva had this stage with markings as in the previous one. Width of head 1.8 mm.

Stage VI. (Normal V).—Head rounded, the apex under joint 2, shining pale brown, reticulated with dark, a dark patch on each side of the clypeus; width 2.3 mm. Cervical shield shining brown, a darker spot before and on the anterior angle, produced backward into a lateral border; dorsal and subdorsal lines faint, pale. Body robust, joint 12 enlarged, joint 13 somewhat perpendicularly truncate, its foot nearly under the hump of joint 12; thorax a little smaller than abdomen. Brown mottled, chocolate on a light yellowish ground. Dorsal line of few white dots in the center of the segments, edged by a dark cloud; subdorsal line similar, more continuous; lateral space heavily dark

shaded; stigmatal band brown, of the ground color, filled with light brown and reddish mottlings, not contrasted; subventral space but a shade darker, mottled. Tubercles in small brown spots; feet pale. Tubercle iv above the center of the spiracle on joints 9 and 10. Posterior parts of subdorsal space segmentarily paler, forming a transverse band of pale on the hump on joint 12. Spiracles black ringed.

Eggs from a moth captured in Denver. The food plant is the wild currant. Eggs May 12, mature larvæ June 24.

The larva of this somewhat striking moth proves to be a very plainly colored, day hiding Noctuid.

XYLINA TORRIDA Smith.

Larva.—Head rounded, not bilobed, erect, green, epistoma and bases of antennæ white; width 3 mm. Body normal, joint 12 not enlarged, joint 13 tapering; robust, cylindrical. Clear green; a straight, white dorsal line on joints 3 to 13, granular shagreened; tubercles small, white; skin minutely white peppered. Subdorsal line narrow, broken, granular, white; traces of a similar lateral line; substigmatal line narrow, granular, pale yellow, from joint 2 to the anal plate. Feet green; spiracles white, finely black rimmed. Tubercle iv at the lower corner of the spiracle. Cervical shield green; anal feet shortly extended backward, white lined. Later there is a white dorsal shade, the stigmatal line is yellow, the subdorsal one obscure.

Pupation in the ground. Larva found on wild cherry in the Platte Canyon May 21; imago emerged September 25.

XYLOMIGES SIMPLEX Walker.

Stage III.—Head rounded, black; width 0.9 mm. Cervical shield quadrate, black; body rather thick, cylindrical, noctuiform, joint 12 scarcely enlarged, very sordid whitish, almost gray, with narrow white dorsal and subdorsal lines, the latter edging the cervical shield; fainter lines along tubercles iv and v. Tubercles round, slightly elevated, black, distinct, normal. Leg plates and anal plate black; feet black; setæ dusky, short; tubercles faintly pale ringed.

Stage IV.—Head shining black, epistoma and bases of antennæ sordid white; width 1.6 mm. Cervical shield black, trisected in white narrowly. Body purplish black, pale mottled; dorsal and subdorsal lines white, discreet, broken; stigmatal band yellowish, luteous centered, including the spiracle and reaching to tubercle v, sharp edged. Tubercles black, rounded, elevated, polished. Setæ rather long, pale. Venter sordid greenish, purplish shadowed.

In stages V and VI the head became red brown, but as I have already described these stages¹ I will not transcribe my notes. The larvæ occurred hiding in spun leaves on wild plum in the Platte Canyon and

¹Can. Ent., XXVI, 1894, p. 21.

on various plants at Sedalia. No moths were bred, but the larvæ are obviously the same as those formerly bred by me, and *Xylomiges simplex* is native to the region, for I took it abundantly at Manitou in May, 1891.

THYREION ROSEA Smith.

Eggs.—Hemispherical, the base flat, about 28 vertical ribs, low, rounded, diminishing regularly by alternation at the upper three-fourths and ending at the micropyle, forming a slightly depressed ring; vertex again a little elevated, reticulate. Cross-striae faint, but the cell areas slightly hollowed, a row on each side of each ridge, the joinings in the hollows and on vertices of ridges which appear somewhat beaded; color pearly white; diameter 0.8, height 0.4 mm.

Stage I.—Head rounded bilobed, mouth pointed, shining black; width 0.4 mm. Cervical shield black, excised at the posterior angles and a little so on the dorsal line posteriorly; anal plate faintly dark tinted. Body normal, white, no marks. Tubercles very small, with moderate, pointed setæ, black. Thoracic feet blackish ringed, abdominal ones normal, equal, pale. On hatching the larvæ entered completely within the leaves of the food plant, where they burrowed between the epidermes.

Stage II.—Head rounded, brown black; width 0.6 mm. Cervical shield and plates dark brown; body all white, immaculate, the small tubercles dark.

Stage III.—Head pale yellowish luteous, sutures, area about eyes and jaws broadly brown; width 0.9 mm. Body all whitish, cervical shield a little shining and a shade yellower, but practically concolorous. Tubercles minute, setæ moderate, dark. Feet normal; spiracles black ringed, rather round.

Stage IV.—Head round, bilobed, compact, and smooth, vertex level, clypeus rather high, nearly reaching the membranous triangle, showing dark brown; sutures and rims of lobes posteriorly blackish; width 1.2 mm. Cervical shield large, the posterior angles rounded, scarcely notched behind, shining light brown, with two detached setæ on the lower side not on a shield. Anal plate shining brown, with dark tubercles. Body all opaquely white, the tubercles small, brown, with short, stiff, dark setæ. Spiracles brown rimmed. Feet normal, the crochets in a neat half circle on the inner side of the planta. Tubercle iv at lower corner of spiracle.

Stages V and VI were not obtained. The larvæ feed at first internally in the leaves of the wild onion, *Allium* sp.; Mr. Osler tells me that he has seen them devour the whole plant, eating down into the bulb. The moth flies at the time the plants are in blossom and rests on the flowers, where it is inconspicuous, its pink and whitish colors harmonizing with those of the blossoms. Found on the prairie near Denver, May 29.

CUCULLIA LAETIFICA Lintner.

Larva.—Head rounded, bilobed, erect, free; white, sutures of clypeus, a broad band from antenna to above clypeus joined by dottings to another band covering the backs of the lobes and sides black; width 3.2 mm. Body greenish white with diffuse, clouded, dorsal, subdorsal (fainter), and stigmatal yellowish bands; curiously black banded. Three irregular transverse bands on each segment; one across tubercles i and ii, widened there, joined by an anteriorly situated dorsal bar, rounded furcate laterally; an irregular dark anterior band and a broken posterior one, enlarged into a subdorsal spot. Irregular black markings subventrally and on the feet; tubercle vi in a white space. Feet normal, equal; thoracic ones black marked; tubercle iv at the lower corner of spiracle or below. In some examples the black is joined in a subdorsal line.

Larvæ at Golden and Sedalia on the prairie near the base of the foothills on a low tufted species of *Chrysothamnus*. Found early in June in the last four larval stages, no marked difference except in size. These handsome larvæ resemble those of a *Pupilio* of the *asterias* group to a remarkable degree. Pupation in the earth in a rather firm cell of considerable size, lined with silk. First imago July 5.

IPI MORPHA PLEONECTUSA Grote.

Larva.—Head broad, slightly bilobed, flat before, white with a broad black band on the angle on each side, irregularly edged, meeting vertically except for the suture; epistoma surrounded by brown; width about 3 mm. Body light green, translucent, densely minutely clear granular. A white dorsal stripe and a narrower broken subdorsal one; substigmatal line white, narrow; all the lines reaching from joint 2 to the anal feet, but the green shield only faintly white lined. Tubercles i and ii white, the rest green, obscure; spiracles flesh colored, dark rimmed; claspers whitish.

The larva was found hiding in a folded leaf made by a Tineid on the cottonwood in Denver. It hid most persistently, and was disturbed on being forcibly exposed. Mature larva early in June; imago July 10.

CISSURA VALENS Henry Edwards.

Stage IV.—Head round, full above, oblique, the apex almost under joint 2, dark gray, heavily mottled reticulate with black on a white ground, leaving a conspicuous white speck on the face of each lobe; width 1.5 mm. Body slender, elongate, the feet on joints 7 and 8 much smaller than the others. Whitish gray, silky, shining; dorsal and addorsal lines gray, dotted powdery; addorsal line straight, widened centrally on the segments; subdorsal line black, waved, bending upward in the incisures. Lateral, suprastigmatal and two subventral lines gray, dotted, confused, subgeminat. Thoracic feet

black tipped, abdominal ones gray dotted. Tubercles in small black spots, ii of joints 12 and 13 larger.

Stage V.—As before, but the ground color pale brown, the reticulations black, the conspicuous fleck white; width 2.8 to 3.1 mm. Dorsal space bordered by the nearly black waved subdorsal band, the gray area above it segmentarily divided, filled centrally with dark dotted mottlings on a pale gray ground. Sides pale gray dotted, a dark band over the spiracles, and subventrally formed by the dottings being darker. Setae long, pale; spiracles dark. The shape is slender, narrowing a little on joints 10 to 13; anal feet rather large, the rest moderate, those of 7 and 8 smaller. Joint 12 very little enlarged. Shields concolorous.

Stage VI.—Head rounded, bilobed, the apex under joint 2; brown, heavily reticulate with black especially in a long transverse patch over the eye; epistoma and basal antennal joint wax white; width 3.7 mm. Body elongate, joint 13 tapering, cylindrical; feet short, pale. Brown, shaded with gray and black. Dorsal space waved, narrowed in the incisures; a broken, mottled, dorsal band and a distinct subdorsal one, irregular about tubercle i, composed of black mottlings on gray, filled between with red dotting on white. A broad, pale lateral space like the dorsal one, narrowly centered with blacker dottings. A black stigmatal band like the subdorsal one, diluted centrally; substigmatal band again pale like the dorsal filling, the subventral area dark, but not so dark as the dorsal marks. Tubercles, i to iv obscure, iv at the upper angle of the spiracle; v and vi large, black. Leg shields whitish, spiracles black; setae rather long and pale. The subdorsal and lateral black bands join posteriorly on joints 12–13, making the anal flap all black. On joint 11 a little white dash at tubercle ii and before spiracle.

Pupation in the ground. Larvæ from Platte Canyon and Sedalia in the foot hills, June 1 to 20, the imago the following March.

Food plant—Oak, young leaves.

SYNEDA HOWLANDII Grote.

Eggs.—Spheroidal, the base slightly flattened, all slightly shining yellowish white, subtranslucent; coarsely pitted, the pits in vertical lines becoming less in number vertically by confluence, rounded, subangular, well defined; the spaces between are broad and too much rounded to look like reticulations. No ribs, the cross ridges as distinct as the vertical ones and like them; irregularly hexagonal. Diameter, 0.9 mm.

Stage I.—Head rounded, oblique, pale brownish with black ocelli and brownish line from them backward; width 0.4 mm. Body sordid whitish, the food green; a diffuse brown lateral band between warts i–ii and iv indistinctly composed of three lines. Shape elongate,

slender, feet on joints 9, 10, and 13, those of 9 and 10 approximate. Tubercles small, black; setæ pointed. Cervical shield concolorous with head; thoracic feet brownish, abdominal ones with dusky plates. After eating, the marks became faint and the larva looked sordid green.

Stage II.—Head rounded, oblique, the lobes bulging; whitish, with three brown bands on each lobe, the upper obliquely clouded, the lower, behind the black ocellus, narrow; with 0.6 mm. Body slender, feet on joints 9 and 10 (approximate) and 13, with minute stubs of feet on joints 7 and 8. Dorsal space greenish white, slightly streaked with traces of dorsal and addorsal lines. Subdorsal, lateral and broad suprastigmatal brown lines on a whitish ground; substigmatal band whitish; two subventral brown bands. Setæ stiff, dark, rather long from very small black tubercles. Thoracic feet black; abdominal ones brown lined. Joint 12 very little humped.

Stage III.—Head white with three geminate lines on each lobe, parallel to those of the body, the upper one abbreviated; width 1 mm. Body slender as before, whitish, subdorsal line double, fine, purplish black, the upper part narrow, waved; three fine lines above the white substigmatal band; three partly confluent and irregular reddish subventral lines and a dotted ventral one. Setæ distinct, dark, but tubercles obsolescent.

Stage IV (Interpolated).—As in the next stage; width of head 1.3 mm.

Stage IV (Normal).—Head white with three geminate, purplish black crinkly bands, reaching from the back of the lobe to the clypeus, pointed at the lower end; an erect mark over epistoma to apex of clypeus; sutures narrowly dark. Shape round, full above, slightly bilobed, larger than joint 2 but the apex a little covered by it, rather pointed at the mouth; setæ dark; width 1.5 mm. Body uniform, slender, the feet of joints 7 and 8 very small rudiments, those of 9 and 10 distinct, approximate, of 13 stretched posteriorly. Gray-white, traces of a dark dorsal line; subdorsal line double, the upper part waved, the lower crossing tubercles i and ii, linear, purple black; a faint single lateral line; suprastigmatal line double like the subdorsal one but straight, the upper part crossing tubercle iii, the lower iv; stigmatal band slightly more white than the ground; three subventral lines a little crinkled and irregular, especially the central one; venter gray-white, a half shade lighter than the dorsum. Feet pale, brown marked. Segments slightly wrinkly annulate especially posteriorly. Tubercles small, black; setæ black, distinct posteriorly.

Stage V.—Head rounded, scarcely bilobed, oblique, large at vertex, higher and wider than joint 2 but the apex retracted; whitish, three geminate gray brown dotted filled bands on each lobe and an erect mark in the clypeus; width 2.3 mm. Body gray, dotted banded. Dorsum brownish dotted filled, spaced by pale from the broad black

dotted, waved subdorsal band; sides very pale dotted filled, pale spaced; suprastigmatal band geminate, nearly black, dotted filled; substigmatal band white, shrunken by the fold, reddish filled. Below it a geminate, sparsely dotted filled reddish line, single subventral line and the pale venter sparsely dotted. The larva gradually tapers posteriorly, joint 13 being the smallest; slender, uniform. Tubercles a little elevated, white, black marked, iv at the middle of the spiracle. Central segments elongated; feet as before.

Stage VI.—Head large, round and full, wider and higher than joint 2 yet the apex retracted in the expanded end of the prothorax; median suture a little depressed, clypeus small. White, mouth a little luteous; an erect black dash in clypeus; three broad bands on each lobe from the occiput converging to the clypeus, black edged, filled with black and brown dots; width over 3 mm. Body slender, cylindrical, elongate; feet on joints 9, 10, and 13, with little rudiments on joints 7 and 8. Broad gray black subdorsal and stigmatal bands, sharply edged, black dotted filled. Dorsal space brown, thickly dotted on an ashy ground; a white speck at tubercle ii before, while the blackish subdorsal band is diluted with brown; lateral space pale ashen, finely dotted in dull red; a pale speck at tubercle iv; substigmatal band like the lateral space; venter sparsely dotted in blackish, illy defining a subventral band, colored like the substigmatal one. Tubercles dark gray, setæ small, dark. Tubercle iv at the lower edge of the spiracle.

Eggs from a moth flying over the foothills at Platte Canyon. The larvæ fed on *Eriogonum*.

SYNEDA HASTINGSII Henry Edwards.

Eggs.—Nearly spherical, a little flattened on the base, very slightly conoidal. Smooth, shining, dull yellow with a greenish olivaceous tint. No reticulations or ribs, the surface covered with slight, shallow depressions, their edges illy defined; diameter 0.8 mm.

Stage I.—Head rounded, oblique, luteous, diffusely brown streaked, scarcely bilobed; clypeus high, ocelli small, black; width 0.4 mm. Body long and slender, motion semilooping, the larvæ thrashing about violently before progressing. Slender, uniform, feet on joints 9, 10, and 13, rather long and well developed. Whitish, green from the food, a faint broad and clouded lateral vinous band. Tubercles very small, black, obscure. Cervical shield brownish, not cornified; feet, except the anal ones, black. Later the lateral shade resolves itself into three distinct lines—subdorsal, lateral, and suprastigmatal. There is a white substigmatal band and faint brown line subventrally; dorsal space whitish.

Stage II.—Head rounded, oblique, the apex under joint 2, full and smooth, the sutures not depressed, clypeus small; whitish, three dotted brown bands on each lobe and a faint linear streak dividing the clypeus

and epistoma. Body long, slender, feet on joints 9, 10, and 13, those of 9 smaller and approximate to 10, a pair of minute stubs on joints 7 and 8. Greenish white, a luteous streak dorsally, divided into segmental dashes swollen centrally; subdorsal line brown, diffuse, black dotted by tubercles i and ii; lateral, suprastigmatal, and two subventral brown lines, not very sharply defined. Thoracic feet black, the abdominal ones dusky. Tubercles round, dark brown, setæ short, stiff, pointed, black. Central segments drawn out, the end ones contracted.

Stage III.—Head as before, the three dotted bands geminate, yellowish white filled; erect brown mark over epistoma does not reach top of clypeus; width 1 mm. Body slender; dorsal line greenish white, widened segmentarily, black dotted edged, centered by a black dotted line broken in the incisures; space to the narrow brown subdorsal (i-ii) line gray; a single lateral, double gray-filled suprastigmatal and substigmatal (between iv and v) lines, the latter white; double subventral and single, somewhat shaded ventral brown lines. Thoracic feet black; abdominal ones brown lined.

Stage IV.—Head shaped as in *Syneda howlandii*, white, striped the same, the three dotted irregular bands on each lobe reddish brown; erect mark in clypeus; width 1.4 mm. Body slender, whitish, gray tinted. Dorsal line single reddish; subdorsal line geminate, purplish brown, dotted, irregular, waved, dark gray shaded segmentarily behind tubercle ii; two lateral and stigmatal dark dotted lines; three fainter subventral ones leaving the substigmatal band a little paler than the ground color. Tubercles in black spots, setæ black.

Stage V.—Head large, full above, higher and wider than joint 2, slightly oblique, the apex retracted; white, three dotted geminate black bands on each lobe narrowed before; an erect mark in clypeus blackish. Gray white, the single dorsal line reddish and widened on joint 2 anteriorly; subdorsal line double, dotted filled, gray shaded behind tubercle ii; lateral line single, suprastigmatal double, obscurely dotted filled; substigmatal band whiter than the ground color; three or four fainter dotted dark lines subventrally, reddish brown. Feet brown dotted, the shape as before.

Stage VI.—The same, but the lines more dotted filled; also the spaces filled in more with reddish dots; width of head 2.3 mm.

I am not sure that this larva is different from that of *Syneda howlandii*. I have given the notes on both somewhat at length, but the lines are all the same and the apparent differences may be due to different wording and to slight variations in the larvæ under observation. The larva of *S. hastingii* did not grow vigorously in the latter stages, as the widths of head show, and was somewhat undersized, possibly with the markings a little undeveloped. It fed on the same species of *Eriogonum* as the other larva.

Eggs from several moths caught flying at Denver and in the foothills.

Family AGARISTIDÆ.

ALYPIA MACCULLOCHII Kirby.

Larva.—Head rounded, bilobed, erect, white, thickly covered with rather large black spots and a few small ones; a yellow shade over vertices of lobes and at bases of antennæ. Body cylindrical, normal, noctuiform, joint 12 slightly enlarged dorsally. White with broad diffuse yellow shades subdorsally (tubercle ii) and substigmatally (tubercle v), the former becoming deep orange on the hump on joint 12. Tubercles large, black, but round and low, not elevated into cones. Many irregular, confused, crinkled black marks. No white subventral spots whatever, the black markings heavy subventrally; venter less heavily marked. Abdominal feet black at the base, flesh colored outwardly; thoracic feet black. Setæ long, white. The black markings form a series of broken lines and dots, a heavy, geminate, dorsal line, widened a little posteriorly on the segments and with a narrow median spur projecting laterally, more sparsely lined where the yellow color is; sides quite heavily marked; subventral region strongly marked, especially above the feet.

Larvæ on *Chamaenerion angustifolium* resting on the backs of the leaves. Found at the Half-Way House above Manitou, July 21. The larvæ entered the earth to pupate in a few days and the first imago emerged May 4 the following season.

Family LASIOCAMPIDÆ.

MALACOSOMA TIGRIS Dyar.¹

Eggs.—Laid in a patch half as long as wide reaching halfway or all around a small twig. Elliptical, flattened on two sides, the larger end squarely truncate, rimmed, the nearly circular center raised; small end rounded. Laid erect on the small end, fastened together by gum, but the exposed ends clear of any varnish; the mass looks white and the spaces between the eggs are visible. Sordid white, a dark micropylar dot. Surface smooth, slightly shining, scarcely shagreened. Size 1 by 0.6 by 0.5 mm.

The egg masses were found on the lower twigs of the food plant, often very near the ground. Exactly similar egg masses were sent to the Department of Agriculture from Jonesboro, Coryell County, Texas, which hatched on April 5. *M. tigris* was then undiscovered and I could not imagine what these eggs were. A memorandum of the food plant was not sent me and the larvæ refused the plants that I offered them. This locality is somewhat distant from the place where I discovered the species; however, I insert my notes on the first stage of the Texan larvæ, as I believe that they are of the same species.

¹ Proc. Ent. Soc. Wash., V, Mar., 1902, p. 38.

Stage I.—Head rounded elliptical, higher than wide, black, epistoma white; setæ long, pale, secondary; width about 0.35 mm. Body normal, black, the anterior edges of the joints pale; a pale-orange subdorsal band on joints 5 to 11, fading out at the ends, sharp above, diffuse below and spreading laterally on the anterior and posterior parts of the segments, most so posteriorly. Subventral fold white. Warts small but elevated, black with small tufts of pale, rather stiff hairs.

Stage II not seen. The following stages are from the Colorado larvæ:

Stage III.—As in the next stage, but the bands more diffuse and paler colored; no blue markings. Width of head 0.7 mm.

Stage IV.—Head round, black, with pale secondary hairs; width 1.2 mm. Body normal for *Malacosoma*; a broad, geminate dorsal band, orange red, widened three times on each segment, most so posteriorly, extending on joints 4 to 11, faintly also on joint 3, suddenly absent on joint 12; a narrow, wavy, cream-colored subdorsal line, absent at the ends; more orange markings laterally with traces of blue dottings between these; a blotched pale orange stigmatal band; subventral folds grayish. Ground color black, velvety on joint 12 and in the incisures of joints 2-3 and 3-4. Hairs rather sparse, of various lengths, faintly reddish, alike.

Stage V.—Width of head 1.8 mm. Much as before, but the lateral stripe is fine and broken and the subventral ones practically obsolete. There is more blue; a dot posteriorly above the subdorsal line, a large patch between that and the lateral line, subventral region blue-gray shaded, joints 12 and 13 blue streaked. Hair reddish dorsally, pale reddish subventrally. Subdorsal line forming a dot on the posterior edges of the segments. Posterior edges of segments yellowish.

Stage VI.—Head rounded, erect, the clypeus small, the paraclypeal pieces forming a shield-shaped area above the clypeus; velvety black, blue powdered, especially along the sutures; many secondary hairs; width, 3.7 mm. Body cylindrical, normal, joint 13 smaller; flaccid; warts obsolete, the hair subtufted dorsally and subventrally anteriorly on the segments, short, rather scant. Velvety black; dorsal line geminate, irregular, mottled, orange, inclosing reddish dorsal hair, widening and divergent posteriorly on the segments, moderately distinct, especially on joint 11, absent on joint 12. Subdorsal line distinct, irregular, broken in the segmental incisures, orange, absent on joints 12 and 13; traces of a lateral and a substigmatal line, orange, the lateral fairly distinct and followed below by orange tinted, white, subventral spots; joint 2 nearly all black. Blue transverse dashes in the subdorsal space, a short anterior and long posterior dash in the lateral space, the latter cutting the lateral line and reaching to the subventral space. On joints 3 and 4 this dash is very marked, curved, edging a

deep black space. Pale reddish or fleshy mottlings posteriorly on the segments in the incisures. The slight subdorsal warts on joint 2 black. A few black hairs dorsally from the obsolete warts i. Traces of a white dorsal line on joints 3 and 4.

Cocoon, as usual, of pale-yellow silk. Larvæ first seen in Mill Gulch, leading out from the Platte Canyon, later farther down the canyon, but not common. At Sedalia, however, they occurred numerously, and had defoliated acres of their food plant. Feeding on the oak, a dwarf tree in this vicinity, but only on the young leaves. Gregarious at first, as usual, but later wandering widely as the young tender leaves become scarce. The larvæ form no tent, but spin a slight web over the branches, which becomes a rather distinct mat at the times of moulting.

This species is nearest to the Californian *M. constricta* Stretch, but quite distinct in the character of the egg covering, which, in that species, consists of a great mass of white, frothy varnish.

Family GEOMETRIDÆ.

EUDULE UNICOLOR Robinson.

Eggs.—Elliptical, evenly rounded, one diameter less than the other, but no flattenings nor truncation; neither end perceptibly depressed. Pale ochraceous, the surface faintly reticulate in whitish, the lines broad, rounded, rather regular, a color, and not any perceptible structure; surface very finely and uniformly granularly shagreened. Skin very delicate, dents in when breathed upon and then flattens out again. Size 0.8 by 0.7 by 0.6 mm. Laid adherent, without threads. The eggs vary in size, some being but half the bulk of others though laid by the same female. Later the eggs turned orange color.

Stage I.—Head rounded bilobed, flat before and rather thin, erect, black. Body slender, greatly elongated, the segments slightly swollen subventrally. Thoracic feet distinct, approximate; abdominal ones small, normal, situated on joints 10 and 13. All pale yellowish, the thoracic feet gray tinted; faint subventral brownish segmentary spots. Tubercles small, black; setæ short, dusky, slightly enlarged at tip. Anal feet with oval blackish shields and a pair of similar convergent shields on the anal flap. A faint, subquadrate, luteous shield subdorsally on joint 2. Setæ of joints 6 to 13 directed obliquely backward, those of joints 2 to 5, obliquely forward.

Stage II.—Head rounded, bilobed, erect, free; dull brown, blotched with darker in the sutures and sides of lobes; width about 0.5 mm. Body slender, elongate, feet normal, approximate at its extremities. Pale brownish, greenish from the food; a broad blotched, partly faint subdorsal brown band; a round dark-brown blotch on tubercle iv on joints 5 to 9 and more faintly on joint 10; tracheal line whitish.

Segments finely obscurely annulate; setæ short, stiff, black; no shields.

The larvæ were not carried to maturity. The eggs came from a female taken in the mouth of Platte Canyon in the foothills, and their food plant was made out so late that they had been four days without food and were so weakened that they died in the second stage. The food plant is violet, but it was only after repeated efforts that this was discovered and a whole day spent in a special journey to the spot where the moth had been caught.

HYDRIOMENE TRIFASCIATA Borkhausen.

Larva.—Head rounded, free, light brown, sparsely mottled, dotted with dark; tubercles darker, as are the sutures and eyes; width about 2 mm. Body robust, flattened cylindrical, normal, smooth. Whitish like the oak-feeding Tortricids and Pyralids, more yellowish white on the ventral half, dorsum somewhat streaked on the annulets. A sordid blackish-green dorsal vascular stripe; an olivaceous luteous, rather broad, stigmatal stripe, red-brown at the spiracles. Tubercles sordid, blackish, moderate. Feet pale, shields concolorous, uncornified; tubercle iv substigmatal, posterior, faintly broadly whitish ringed.

The larvæ occurred on the oak, hiding between leaves and with the aspect of Pyralids, but true Geometrids in structure. They were found by Mr. E. J. Osler, at Cheyenne Canyon, near Colorado Springs.

SCIAGRAPHIA PERVOLATA Hulst.

Larva.—Head rounded bilobed, the lobes squarish, erect, flattened a little before; gray white, a broad black band over the vertices of the lobes and another across from eyes, but leaving the epistoma pale; black dots between the bands; width 1.8 mm. Body normal, not greatly elongate; tubercles elevated; setæ coarse and black. Bark gray; ground color whitish dorsally, but gray between tubercles i and ii; a reddish subdorsal band broken into spots below tubercles i and ii, the rest whitish. Lateral area gray mottled, the substigmatal fold white anteriorly on the segments; venter marked and dotted with grayish black. Tubercle vi double, or of two separate tubercles; i and ii nearly in line, the rest as usual; the tubercles of vii moderately separated. Plates spotted like the body, uncornified.

Found on wild gooseberry in the Platte Canyon, May 18; imago June 12. I am not sure that the moth is correctly named. I could not find any description to exactly fit the specimens: that of *S. pervolata* seems the nearest. The moths have the wings whitish gray, rather coarsely brown strigose; transverse anterior and posterior lines represented by diffuse clouds, the latter bent outward opposite the cell. A black patch at costa and at middle of wing occur just beyond the transverse posterior line and adjoin a broad, pale, ill-defined sub

terminal band; a terminal broken black line. Hind wings finely strigose, the margin wavy with brown discal dot and a shadow of a median line.

DIASTICTIS OCCIDUARIA Packard.

Larva.—Head rounded, erect, squarish, clypeus rather high; whitish, a large black patch covering vertex of each lobe and extending half way down the sides and front, leaving the median suture broadly pale; an angled patch over ocelli and one on lower part of clypeus, pointed above; epistoma pale, mouth black; width 1.6 mm. Body cylindrical, normal, the segments not elongated; feet rather small. Ground sordid white, with many black marks and two brick-red bands. Dorsal and stigmatal bands diffuse, red, the latter broken at the spiracles by the white ground color. Large black spots about tubercles i, ii, and iii, with numerous smaller dots between; iv and v black, v small; a continuous black subventral band, covering tubercle vi, below which the venter is pale gray, dotted by the scattered black tubercles vii and viii, sparsely mottled, becoming pinkish medially. Thoracic feet and spiracles black, abdominal feet gray, like the venter, with black tubercles. No shields; joints 2 and 13 white and black spotted, concolorous. Setae black, short, stiff.

Found by Mr. Oslar on the ground under willows near Denver. They did not feed, being matured. Moth, May 30.

ALCIS HAYDENATA Packard.

Eggs.—Shortly elliptical, nearly spherical, one diameter a little less but no flattening or truncation; about 14 longitudinal ribs, low, distinct, running to the antemicropylar end where they meet in a slightly confused reticulation. At the other end they stop abruptly at a ridge which represents the edge of the obsolete truncation; end reticulate. Ribs nearly straight, dotted faintly with two rows of pores; cross striae fine, parallel, not raised, not very distinct. Pale green; diameter 0.9 mm., the difference between the two diameters scarcely measurable.

Laid loose, rolling about in the jar.

Stage I.—Head rounded, mouth rather flatly truncate; dark brown, labrum and antennae whitish; width 0.35 mm. Body cylindrical, normal; moderately elongate. White; joints 2-4 and 10-13 look a little swollen and are honey yellowish; six red-brown transverse bands on the posterior halves of the segments 4 to 9, joined by a subdorsal line that is wide next to the posterior band, and nearly detached on the anterior rim of the segment; a lateral, more regular line, reaching nearly the whole length; bands broadly blotched on the venter and joined by a fine adventral line. Joints 2-4 and 10-13 marked over the yellowish with clouded dorsal and subdorsal purple-brown lines. Cervical shield and anal plate darkly sordid shaded. Feet dark, nearly black; the thorax and head held so as to look like a single black knot. Feet of

joint 10 paler, especially outwardly. Tubercles and setæ obscure, concolorous and pale.

Stage II.—Head round, bilobed, erect, flattish over the moderate clypeus; dark brown, a disjointed, submaculate, white band over the lobes to the clypeus, a large spot in clypeus, epistoma diffusely whitish, setæ pale; width 0.6 mm. Body cylindrical, moderate, normal. Posterior three-fifths of segments 5 to 9 banded in purplish brown, joined by a subdorsal line, widened where it joins the band in the centers of the segments. A finely linear dorsal line; venter wholly brown, only slightly streaked in whitish. Anterior two-fifths of segments white, annulate and slightly lumpy, cut into dorsal and lateral patches by the distinct subdorsal line. Joints 2 to 4 with the white predominating; dorsal and subdorsal lines uniform, subventral region brown, annulet incisures sordid. Joints 10 to 13 mostly brown, the dorsum luteous diluted; subdorsal, lateral and stigmatal white bands, submaculate, a little lumpy elevated. Feet brown, the abdominal ones white dotted.

Stage III.—Head rounded, flattened before, slightly bilobed, erect; dark brown, a white dotted edged band over the vertex of each lobe to the clypeus which contains some white dots; base of antennæ and mot-tlings on sides below pale; width 0.9 mm. Body moderate, cylindrical, normal. Segments finely irregularly annulate, not greatly elongate. Dorsal band white, widened segmentarily, sordid shaded; subdorsal dark brown, on joints 5 to 9 composed of intersegmental ellipses, narrowly joined and covering all of the lateral space, narrow on the thorax, confused and pale on joints 10–13. Lateral space white on the segments, narrowed to obsolescence in the incisures. Venter broadly dark brown, finely obscurely lined in pale. Feet brown, the abdominal ones whitish lined outwardly. Joint 2 dorsally dark brown as also the tip of the anal flap. White marks slightly mottled and cut by the annulet incisures, also slightly lumpy and folded on the sides. Tubercles and setæ obscure.

Stage IV.—Head rounded, scarcely bilobed, erect; brown-black, white dotted; a broad, short, pulverulently edged, white band on vertex of each lobe, cut off before into a dot; bases of antennæ and epistoma white; width, 1.3 mm. Body as before, black-brown with dorsal and stigmatal, continuous, segmentarily widened, white bands, nearly pure, cut by the fine annulets, containing black dots at tubercles i and iii, respectively. Dorsal band broad on joints 2 to 4, double on joint 2 with triplicate brown center, broadly blurred on joints 3 and 4, brown dotted; powdered and confused with dots on joints 10–12; joint 13 white dotted. Lateral band uniform on joints 2 to 13, the feet of 10 and 13 narrowly white lined without, otherwise dark. Venter finely, faintly lined. Faint orange blotches behind the spiracles.

Stage V.—Head squarish, rounded, thick, flattish before, vertex slightly notched; black, finely white dotted; a broad, rectangular band

on the vertex of each lobe, white, containing two black dots; epistoma white. Dots small, mostly uniform, a little strigose and wavy, especially in the clypeus; width 1.7 mm. Body normal, rather robust; brown-black; a broad distinct, sharply edged, white band, narrowed at the segmental incisures, a similar stigmatal one faintly orange blotched below and between the spiracles. Subdorsal space velvety, finely white dotted like the head; venter finely lined in whitish, pulverulently; medio-ventral band rather broad, cloudy triplicate. On thorax the dorsal band replaced by a pair of subdorsal bands, creamy orange tinted, irregular, subconfluent. On 10-13 dorsal band widened, more irregular and containing black dots; tubercle ii of 12 enlarged, white; anal flap black-brown, white dotted; a white bar from the stigmatal line on the upper halves of the feet of joints 10 and 13. Feet and spiracles black; tubercles small; setae fine, short, dark. Segments finely and rather numerous annulate, finely so anteriorly and posteriorly.

Eggs from a female taken at Pine Grove, July 19. The larva reached the stage last described September 29 and began to hibernate, but had not enough vitality to survive the winter. It was apparently not mature. It fed on wild cherry and *Polygonum*.

ENEMERA JUTURNARIA Guenée.

Egg.—Elliptical, one diameter much less than the other but not sharply flattened, not depressed at either end; micropylar end roundly truncate, the other abruptly rounded, both about alike but differentiated by the sculpturing; truncation slightly oblique. The two sides are not symmetrical. The egg is laid loose, rolling about, and if rolled, always stops with the same side up. This side has a single median impressed groove; the lower side two such grooves. Twelve broad, longitudinal, raised ridges join a similar ridge about the rim of the truncation, broadly wavy, rounded, beaded with a double row of minute pores, joined by diffuse transverse ridges to form squares and also by numerous fine, obscure, transverse lines, about eight to the square. Beginning one square from each end the two central ridges are approximated, the space between depressed as a deep, smooth groove. On the other side the two median hollows are depressed, their bordering ridges less sharply approximate, the grooves crossed by striae. In one egg the double grooves began, one of them at one square, the other at two squares from the truncation, but both ended sharply and evenly at one square from the other end. In another egg this was reversed. In still another there was but a single groove, but it was not central and was less deeply marked than the dorsal one. Micropylar end coarsely reticulate, the upper end lumpy from the confused ridges. Color green, turning dull pink, with the ridges paler. Size, 0.9 by 0.7 by 0.5 mm. Eggs from three females examined, alike

with the variation indicated. The ridges overhang the dorsal groove, projecting as white rims, serrated by the projected pores, which appear as little brown teeth. Ventral grooves more variable, not overhung by the ridges.

The eggs were obtained in July, but did not hatch till the following April. They are evidently scattered over the ground by the moths, where they lie all the autumn and winter. The dry climate doubtless favors their preservation, while their peculiar ribbed structure may serve as a safeguard against too much dryness.

I have described the larva previously.¹

EPIPLATYMETRA COLORADARIA Grote and Robinson.

Eggs.—Laid adherent; elliptical, one diameter considerably less, rounded, rather squarely; both ends abruptly rounded, about alike, not really truncate; center a little constricted and one end a little depressed. About 14 low raised ridges, longitudinal, parallel, stopping at the rim at the micropylar end, reaching the other end confused into reticulations. They carry a double row of pores but obscure, rounded; cross striæ fine, obscure, parallel, not raised. Color pale whitish green. Size 1.1 by 0.8 by 0.6 mm. The rim about the micropylar flattening is more distinct than the ribs; the end is nearly smooth, slightly radially reticulate near the rim.

Stage I.—Head rounded, very slightly bilobed, oblique; very pale brown, a little vertically streaked. Body moderate, normal, whitish, a broad, straight, distinct, pale purple-brown band subdorsally on joints 2 to 13, not quite reaching the end, the pair separate, only touching at the middle of joint 13, where they terminate. A similar broad, pale-brown ventral band. Feet pale, ocelli black, sutures of the moderate clypeus brown.

The eggs were obtained from a female moth at Pine Grove, Colorado, in the foothills at an altitude of 8,000 feet, but no suitable plant could be found for the young larvæ when they hatched.

Family NOTODONTIDÆ.

ODONTOSIA ELEGANS Strecker.

Egg.—Hemispherical, the base flat; opaquely white, not shining; finely and densely covered with small, white granulations, arranged obscurely in vertical lines, a little denser about the vertex, which is narrowly clear with a small central white space. Diameter 1.4 mm.

Stage I.—Head bilobed, free, shining black, the sutures broadly and lower parts of lobes diluted brown; width 0.65 mm. Body cylindrical, normal, anal feet elevated, segments subannulate. White, shining, the quadrate cervical shield, anal plate, leg plates, thoracic

¹Entom. News, V, 1895, p. 63.

feet, and tubercles shining black. A faint vinous shading dorsally on joints 4, 5, 6, and 12, and distinct subventral sordid vinous blotches the whole length. Tubercles normal, *ib* and *iii*, especially *iii*, larger, *ia* and *ib* separate, *iv* behind the spiracle; no subprimaries. Tubercles distinct, polished, black, the setae pale and obscure. Joint 12 slightly enlarged, tubercles *i* and *ii* of joint 13 anteriorly in a square; joint 11 rather weak. The larva ate patches halfway through the leaf on the upper surface and rested beside them.

Stage II.—Head erect, high, narrowing above, a low vertical notch, flattish before; pale luteous, the vertices of lobes narrowly tipped in smoky brown, ocelli dark; width 1.2 mm. Body cylindrical, joint 12 slightly enlarged, anal feet weak, approximate, but used. Whitish green, smooth, a white subdorsal line; subventer and feet broadly dark vinous, the anal ones only narrowly lined with this color; thoracic feet black. Tubercles large, a little elevated, but whitish, almost concolorous with the body, inconspicuous. Segments irregularly annulate; no shields.

Stage III.—Head pale greenish luteous, punctate dotted in darker, the sutures of mouth brown, sutures of clypeus and a central line also dark; ocelli blackish; width 1.6 mm. Body cylindrical, normal, joint 12 with a small, sharp, dorsal hump. Green, yellowish shaded on the thorax and along stigmatal line, subventer blotched with vinous, running down on the outer sides of the feet. Anal feet small, vinous lined, used. Spiracles small, black ringed. Segments subannulate, slightly shining, joint 6 with a very slight annular swelling.

Stage IV.—Head high, flattened before and at the sides, vertex slightly notched; pale green, blotched with dull red on the sides below and about the mouth, shading upward; width 2.5 mm. Body cylindrical, joint 6 with a central, slight, collared elevation, 12 with a broad, low hump. Green, the space between the spiracles and the feet broadly shaded in purple brown, slightly shading upward toward the dorsum, more distinctly on the hump and quite darkly on the annular elevation of joint 6. Thoracic feet and abdominal ones outwardly dark purple brown; spiracles black ringed. Tubercles slightly elevated, green; anal feet small, used. Venter broadly pale green. The transverse purple lines of joints 6 and 12 become more distinct with growth. Later the dull vinous color shades nearly up to the dorsal line, the purple dorsal ridges of joints 6 and 12 are slightly relieved by whitish.

Stage V.—Head higher and wider than joint 2, rounded, flattened on the front and sides, narrowed a little above and slightly bilobed; shining, smooth, yellowish green from the clypeus to vertex centrally, the clypeus and sides shade in dark brownish red; mouth dark red; surface shagreened slightly, making the red shade mottled-reticulate in greenish; width, 3.5 mm. Body cylindrical, joints 6 and 12 with

low, collared, dorsal humps; anal plate rounded, smooth, small; no shields. Feet moderate, equal, the anal pair a little smaller, but used in walking. Dorsum shaded in vinous brown mixed with grayish, only a trace of green in the incisures dorsally; venter narrowly green. Thoracic feet red-brown, the foot of joint 7 and the others in a less degree with a purple brown streak outwardly. Humps narrowly pale gray, spotted and streaked in purplish black. Tubercles whitish with black hair dots, a little elevated, distinct, normal. Spiracles large, white, black rimmed. The dark mark on the hump of joint 6 is an irregular black band from behind the spiracle over the dorsum and an elongate spot between tubercles i and iii. Joints 2 to 5 are more reddish than 6 to 13, having no gray; the hump of joint 12 is reddish and the gray consists of traces of the collar markings of joints 7 to 11, most distinct at the spiracles. Later joints 2 to 6 are a little smaller in diameter than the rest of the body, joint 2 slightly widened and pale on the sides. The body becomes all lilaceous except narrowly ventrally with the same marks, but no distinctly different reddish tints. Anal plate with a narrow red rim.

Larvæ found on aspen at Bailey's in the Platte Canyon, mixed with *Pheosia dimidiata*, which they greatly resembled in the egg stage. A larva entered the earth to pupate July 31, and the moth emerged May 6 the following season.

In the last stage the larva rests on the twigs of its food plant, which it closely mimics in shape and color.

Family COCHLIDIIDÆ.

TORTRICIDIA TESTACEA Packard, variety CRYPTA Dyar.

I had no expectation of finding a slug caterpillar in Colorado, as the climate seems too dry. However, Mr. Caudell netted a female moth in a narrow, wooded gulch leading off from the Platte Canyon, not far below Bear Gulch. The moth differs only slightly from the Eastern *Tortricidia testacea*, being paler and less strongly dark shaded, but the larva shows some rather unexpected differences, showing it to be a distinct local variety of that species. The pattern of markings is more generalized in the Rocky Mountain race.

Eggs.—Elliptical, flat, but rather thick and arched, translucent, slightly yellowish, the reticulations obscure; size, 0.8 by 0.5 mm., all as usual in the family.

Stage I.—As in the Eastern species, the subdorsal spines Y-shaped, the anterior prong shortened on the hinder segments, especially on joint 11; not strongly alternating, yet perceptibly so; greenish translucent, the ridges whitish; head green, eye black, mouth brown; skin smooth. All normal, no markings.

Stage II.—Elliptical, joint 13 quadrate, normal, narrowed behind. Depressed spaces large and deep, all present; ridges and latticed elevations between the depressed spaces densely papillose granular, especially around the margin; setæ distinct, short, dark, pointed, normal. All faintly whitish; latticed ridges of dorsal space 1 granule wide.

Stage III.—Elliptical, normal. Green, a yellow subdorsal line centrally, reaching farther posteriorly than anteriorly; a round, red spot crossing the subdorsal lines, but yellow edged and paler centered, situated on joints 7 and 8.

Stage IV.—The purplish-red spot is rounded, a little larger than before; yellow subdorsal line not quite reaching the extremities. The larva now eats the whole leaf.

Stage V.—The patch is irregularly triangular, occupying about a third of the dorsum; it covers depressed spaces (1) of five joints and reaches the middle of the side; a red dash on joint 3. The yellow lines reach to the anal end, but not to the head.

Stage VI.—The patch reaches the anterior and posterior extremities narrowly, on the sides to the depressed space (4) of joints 7 and 8, with a little point toward (4) of joints 6 and 9. It is as in the normal *T. testacea*, except that the patch did not reach below the middle of the side, being exactly as in some fully marked examples of *T. cæsonia*. The larva had but six stages.

Eggs June 1, mature larva July 14.

Family PYRALIDÆ.

MELITARA JUNCTOLINEELLA Hulst.

Larva.—Head rounded, slightly bilobed, held flatly; clypeus nearly reaching vertex, the sutures depressed; bright red-brown, epistoma paler, ocelli black; width 2.1 mm. Body slightly flattened, the segments strongly 2-annulate; cervical shield large but rather narrow, transverse, shining black; anal plate very large, black. Tubercles small, black, i and ii in line, iv + v, normal. Feet with the crochets in an ellipse. Dark purplish, nearly black; skin coarsely wrinkly shagreened; spiracles rounded, black. Thoracic feet brown; setæ fine, brown, rather long. On the thorax ia + ib, iia + iib; on joint 13 anteriorly a medio-dorsal shield and on joint 2 a small crescent before the spiracle, not contrasted.

Larvæ feeding gregariously within the leaves of the prickly pear cactus were found on the prairie near Denver, May 11. They had obviously passed the winter as half-grown larvæ in this situation and were feeding rapidly. However, it proved impossible to breed them, and the above supposition as to their identity was gained from the capture of a female moth on the prairie near Golden, June 5.

ACROBASIS BETULELLA Hulst.

Larva.—Head round, black, coarsely shagreened, epistoma sordid white. Body purplish black, the segments coarsely 3-annulate, not shining. Tubercles small, black, corrugated radially, iv and v closely approximate, in line. Anal plate black; feet normal, setæ rather long, fine.

Spinning a web among the leaves of birch and living in a cone made of frass united with silk. Platte Canyon; imago July 1.

PIONEA BELIALIS Druce.

Larva.—Head small, flat, half retracted in joint 2, black, the sutures pale. Cervical shield bisected into two quadrangular halves, distinctly separate. Body nearly cylindrical, uniform, robust, incisures only slightly marked; anal plate brownish, feet normal. Pale yellow with large, conspicuous, round, black tubercles; ia+ib, iia+iib, iv+v, iiii present, large, situated above and before the spiracle, vii a single brown-black tubercle, viii distinct on the legless segments. Crochets of abdominal feet in a broad ellipse, narrowly broken outwardly. Thoracic feet black, the abdominal ones like the body. Spiracles small, black-rimmed.

The larvæ are leaf miners in an herbaceous, aromatic plant, *Coleosanthus grandiflora*, growing in bunches in moist spots in the foothills. I found them in a gulch near the mouth of the Platte Canyon. The mine forms a large brown blotch extending through to both epidermes at the terminal part of a leaf, occupying three-fourths or more of the surface. At maturity, the larva emerges and spins up a three-cornered box in one of the soft, young leaves at the end of the shoot where it pupates. This leaf becomes wrinkled with growth.

Larvæ found matured July 11, at which time there were only a few left, most having pupated. The moths began to emerge at once.

A Tachinid parasite, *Isoglossa hastata* Coquillett, was raised from the larvæ.

A specimen of the moth was sent to Prof. C. H. Fernald, who says that it should be referred to the genus *Cybalomia*. He adds that it reminds him in appearance of *Titanio helianthiales* Murtfeldt, which is also a leaf miner in the larval state.

Family PTEROPHORIDÆ.

OXYPTILUS DELAWARICUS Zeller.

Larva.—Head rounded, whitish. Body light green with a rather broad white subdorsal stripe, containing a round creamy patch on joints 6 and 7; feet normal, slender. Tubercles i and ii united, single haired, the hair of i leaning forward, ii backward; tubercle iii single haired, leaning forward, iv and v united, not strongly oblique; vi

single haired, directed backward; vii with three hairs on the leg base, one stronger than the others; no secondary hairs, the skin finely granular. On the thorax tubercles ia and ib united, iia+iib, iii+iv+v, vi double. No shield, but six setae in two rows, three on the prespiracular wart and two on the subventral.

The pupa is winged as in *O. periscelidactylus* Fitch.

Larvæ on the wild grape in the Platte Canyon, June 1, moth out June 11. The larvæ were mature when found and ready to pupate, but there was no sign on the plants of spun up leaves, such as the allied species makes.

The specimens were at first determined as *O. periscelidactylus*, as they agree with a moth so labeled by Professor Fernald, bred at the Department of Agriculture on grape (No. 4440). The wide dissimilarity of the larvæ (*O. periscelidactylus* has warts and secondary hairs) led me to reexamine the moths. *O. delawaricus* is extremely similar to *O. periscelidactylus*, much more so than the descriptions by Walsingham and Fernald would imply. It is smaller, the palpi are shorter, the antennæ completely white ringed, and the space between the white lines on the feathers of the fore wing is dark brown, contrasting with the rest of the wing. Otherwise I see no differential characters.

The following are the notes made at the Department of Agriculture on the number 4440, above referred to:

May 29, 1889. Tortricid? on grape from J. B. Schaffer, Deward, Pennsylvania. Larvæ uniformly greenish yellow with darker median line and somewhat paler head. The hairs arising from the warts are long, rather coarse, and colorless. * * * They remind one of *Nola*. Moths issued June 9-11.

PTEROPHORUS SULPHUREODACTYLUS Packard.

Larva.—Thick, flattened, tapering at the ends; feet normal, slender. Head rounded, bilobed, the apex under joint 2, mouth projecting; width about 1.2 mm.; black, the sutures broadly brown. Body without secondary hairs, the warts low and diffuse; i with three or four, ii with one hair, these warts somewhat approximate; iii with several hairs; a group of six hairs on the subventral fold without wart and a hair posteriorly in line, absent on some segments; several hairs for tubercle vi. Olivaceous green, a broken, broad, sordid white subdorsal line along warts i and ii with four black dots on each segment between in a square, becoming black blotches on the posterior segments. Wart iii pale; spiracles black; skin finely dark granular; cervical shield blackish, hairy; thoracic feet black, the abdominal ones pale. Hair white, minutely glandular tipped; segments obscurely 2-annulate; a black impressed lateral dot in the middle of the segment.

The larvæ were found webbing up the young heads of a wild sunflower, *Helianthus pumilus*, and feeding within the spun mass. They occurred on the foothills near Boulder Creek Canyon. Spun among dead leaves; emerged June 10.

PLATYPTILIA COSMODACTYLA Huebner.

Larva.—Head round, vertically bilobed posteriorly, pale testaceous. Body cylindrical, normal, green, a dull crimson dorsal line with a small oblique subdorsal dash on joint 6 and a dash on joints 5 to 12; a white subdorsal line from joint 2 posteriorly to 13 anteriorly and a broken subdorsal one the larger anterior part on each segment oblique. Tubercles small, hairs single, i and ii separate, iv and v approximate, v anterior and dorsal to iv. On thorax ia+ib, iia+iib, iv+v, numerous fine, short, secondary hairs, shorter and easily differentiated from the primary ones, bulbous tipped. Hairs all white, not long, inconspicuous.

The larva was found resting on the red fruit bract of *Lonicera involucrata*, and was not observed to feed, being matured and pupating immediately. Apparently the larvæ do not eat the leaves, but more probably the flowers. Found at Pine Grove, Platte Canyon, altitude about 7,000 feet.

ALUCITA CINERASCENS Walsingham.

Larva.—Head long, the mouth pointed, apex under joint 2; whitish. Body flattened, narrow, not tapering. Tubercles i and ii approximate with one long and several short hairs, iii singled haired, iiib several haired, iv+v large, many haired, the others retracted subventrally. Translucent green, with obscure, straight, subdorsal and broken lateral lines, the latter above tubercle iii. Warts black, i+ii largely so, and forming a double row of distinct spots separated by a straight line of the ground color. Anterior edge of joint 2, posterior rim of reduced cervical shield and warts of anal flap also black marked. Hairs white, spinulose; none secondary. Pupa free, not in a cocoon.

Larvæ in the heads of *Helianthus pumilus*, near Boulder Creek Canyon, May 23; moths issued June 12. Eggs were obtained from these which passed the winter without hatching, showing the species to be single brooded with hibernation in the egg state.

Egg.—Oviform, elliptical, one end more pointed than the other, both slightly truncate at the extreme tips, strongly and sharply flattened on two sides, like cakes cut out of dough; pale yellow, opaque, not shining, the surface slightly shagreened, not sculptured. Size, 0.55 by 0.4 by 0.15 mm.

Family TORTRICIDÆ.

TERAS FOLIANA Walsingham.

Larva.—Head rounded, the apex under joint 2, paraclypeal pieces reaching vertex; red brown, shaded sordid at the mouth, ocelli black; width 1.2 mm. Body translucent, soft green, not shining; cervical

shield large, pale luteous, black rimmed posteriorly. Tubercles large, colorless, a little elevated, normal, iv+v. Male glands large, dark purple. Feet and setæ pale, no marks.

Abundant on the *Cerocarpus parvifolius*, folding the leaves and living within the houses so formed; pupa in a folded leaf. Some of the bushes suffered severely from these larvæ. The moths were common flying over the dry foothills in July among the *Cerocarpus* bushes at Platte Canyon and Manitou; doubtless also throughout the range.

CACOEZIA ARGYROSPILA Walker.

Larva.—Head pale luteous brown, a black line on sides and ocelli black, jaws brown. Body green, cervical shield all green, translucent, tubercles pale, a little elevated, normal; no marks.

Another larva had the head pale brown with a darker line along the side on ocelli and jaws. Cervical shield all translucent green with a trace of brown tint, unbordered. Body all green; first pair of thoracic feet black, the rest green. Dorsal vessel dark.

Another larva had the head black, diluted with whitish irregularly on the face; thoracic feet black ringed, those of joint 4 less strongly so. Cervical shield black edged, luteous centrally, shading to whitish translucent in front. Body all green.

Another larva had the head greenish testaceous, black below at mouth but epistoma pale; width 1.5 mm. Cervical shield translucent greenish testaceous, shading to brown-black at the edges. Body translucent sordid green, slightly olivaceous dorsally, tubercles broadly paler, elevated, rather large; segments coarsely 2-annulate dorsally; male glands faintly yellow. Setæ long, pale, normal; ia+ib, iia+iib, iv+v. No anal plate. First two pairs of thoracic feet blackish marked, the last pair brownish.

I give these several descriptions to illustrate the variability of this larva. It is especially unfortunate, as the larvæ of several other Tortricids are closely similar to this and hard enough to distinguish anyway. The species occurred on oak, willow, ash, and box elder, generally distributed but not locally very abundant.

CACOEZIA VIVIDANA Dyar.

Larva.—Head slightly bilobed, flat, jet-black or partly diluted on the face; cervical shield luteous except for dots at the borders. Body slender, cylindrical, the feet short, segments irregularly 3-annulate. Sordid translucent green, a clearer dorsal and subdorsal line; tubercles round, white, distinct, with coarse white setæ; iv+v. Spiracles black ringed; thoracic feet black with paler joints, abdominal ones pale. Dorsum faintly olivaceous shaded. Male glands in joint 9 showing as an ochraceous shade.

Webbing up the leaves of *Rubus deliciosus* in the Platte Canyon,

May 25. Others from wild cherry mixed with *Cenopsis directana*, from which I do not know how to distinguish them. This is not more than a variety of *Cacoecia argyrosbila*; it has the same markings, but bright red brown on a pale yellow ground. All the specimens are from Colorado, while *C. argyrosbila* is widely distributed. I have thought best to give it a distinctive name. It has been bred at the Department of Agriculture under the No. 4464.

CACOEZIA SEMIFERANA Walker.

Larva.—Head black, diluted whitish on the face; cervical shield greenish, black on the edges. Body translucent green, blackish from the food. Male glands yellowish, subventral fold somewhat opaque. Feet pale, those of joint 2 black.

Webbing the leaves of oak and apparently confined to this tree. A number of very young ones were collected in the Platte Canyon May 18, mixed with other Miero larvæ on the young oak leaves. Imago, June 11.

CACOEZIA NUGUNDANA Dyar.

Larva.—Head rounded, obliquely extended, pale green, ocelli black, jaws brown. Body tortriciform, slender, normal, rapidly moving. All translucent pale green, tubercles inconspicuous, concolorous, setæ pale and rather long; dorsal vessel dark. Male glands light yellow, distinct. Feet green; no marks.

Spinning up the leaves of the box elder, defoliating the trees in Denver and Golden, not seen on any of the trees in the Platte Canyon. The moth is very like *C. semifera*, but is very markedly paler; I think it a distinct species. The larva is always entirely green in all stages while the other larva has a black head, only becoming whitish on the face in the last stage. The food plants seem constant for both.

Professor Fernald tells me that Professor Riley had named this moth after its food plant as I have done, but I am not aware of any published description nor was he.

CACOEZIA CERASIVORANA Fitch.

These well-known larvæ were found in the Platte Canyon, webbing up a mass of leaves of the wild cherry into a head, within which a large number of them were found. Head, shields, and tubercles are black, the body shaded blackish all over. Male glands yellowish. Imago, June 24.

CACOEZIA ROSACEANA Harris.

Larva.—Head brownish luteous, epistoma white, apex under joint 2. Body all green, slightly shining, no marks; cervical shield large, green, narrowly black rimmed at the sides and behind continuously. Tubercles small, slightly elevated. Thoracic feet pale, the anterior ones dark brown; crochets of abdominal feet in an ellipse.

Other larvæ had the head black or partly brown over the vertex; shield diluted green in front, brown centrally. Body all green without dorsal shade, the feet of joint 2 black. These were bred from a large patch of eggs laid in a flat mass overlapping like shingles. The eggs were on a woodbine leaf, but the larvæ did not like this plant. I bred them on wild cherry. Other larvæ taken on plum, wild cherry, and oak. In stage I the head was shining black, mouth paler; bilobed, held obliquely. Body slender, submoniliform; all pale yellow without shields or plates. Tubercles obsolete, setæ obscure. In stage II the head was pale luteous, the body greenish, transparent, no marks. After that the head and cervical shield were black till the last stage, when the black was more or less replaced by luteous brown. Moths issued August 9.

LOPHODERUS COLORADANA Fernald.

Larva.—Head whitish, bilobed, partly under joint 2. Body slender, all pale green, translucent; segments 3-annulate; tubercles whitish, a little elevated, under lens concolorous, colorless, elevated, and moderately large; iv+v. Shield all concolorous, no marks. Feet normal, crochets in a complete ellipse of several rows.

Spinning a somewhat tube-like web in the seed heads of *Pulsatilla hirsutinum* high on the foothills back of Golden.

CENOPIS DIRECTANA Walker.

Larva.—Head and shield black; width 1.5 mm. Body green, broadly olivaceous shaded dorsally, leaving the tubercles pale, joint 13 green. Thoracic feet black, abdominal ones short, normal. Other larvæ had the head mahogany red, the sutures black; cervical shield partly brown-red in front.

The larvæ occurred on wild cherry in the Platte Canyon in May. The moth is very variable, but a distinct species, I think. Professor Fernald makes it a synonym of *C. reticulatana*,¹ but it may be separated from Northern specimens that I have under that name. Lord Walsingham's figure² can be closely matched by some of my specimens. Others are much suffused with brown.

PLATYNOTA LABIOSANA Zeller.

Larva.—Head flat, the apex under joint 2; shining black, the epistoma and bases of antennæ white; width about 1.2 mm. Body slender, flexible, tapering a little at the ends, scarcely flattened; segments strongly 3-annulate, creased in the incisures. Cervical shield large, black, narrowly bisected by pale; prespiracular and subventral tubercles large, black; thoracic feet shining black, abdominal ones short,

¹Trans. Am. Ent. Soc., X, 1882, p. 20.

²Ill. Lep. Het. Brit. Mus., IV, 1879, pl. LXIV, fig. 4.

normal, green, slightly dark shaded; anal pair dull black. Body slightly translucent sordid olivaceous green, dorsal vessel narrowly dark; the subventral fold looks lighter when well folded; no marks. Tubercles rounded, rather small, slightly elevated, with black hair-tubercles, but the plate concolorous with the skin; iv+v, ia+ib, iia+iib, one above the other. Spiracles black with pale centers. Setae rather long, dusky.

Webbing up the leaves and stem of *Argemone mexicana*, the pupa in a folded leaf with the end bitten off. Often injurious to the plant, as they eat the growing stem, distorting the plant. Also found on a species of *Gilia*, but perhaps as an accident. Found at Golden and Boulder, near or on the prairie.

The United States National Museum has fragments of two specimens, one labeled in Zeller's handwriting, the other taken by Belfrage in Texas, July 2. Mr. Busck thinks that they may have been part of Zeller's types; they certainly agree with his description. My specimens run larger, though some are of the same size, and the banding on the fore wings is heavier, not being so much confined to the costal edge as in Zeller's specimens. But the sexes are marked alike, which confirms me in the determination, as it is an unusual character in this genus.

Family YPONOMEUTIDÆ.

ORCHEMIA DIANA Huebner.¹

Larva.—Head rounded, bilobed, sutures depressed, pale reddish, whitish on the paraclypeal pieces and mouth, a black line on the posterior side of lobes. Body slender, tapering a little at the ends; translucent greenish yellow, scarcely distinctly colored; a dull white dorsal band of pigment, somewhat cut by the annulets, touching tubercle i, well defined. Tubercles large, black, round, a little elevated; iv+v, normal. A diffuse yellowish white stigmatal band. Setae moderate, pale. The food shows dark green or sordid, being especially visible subdorsally.

Cocoon large, a broad sheet of white silk, under which the true cocoon is formed, tube like, enlarged in the middle.

The larvæ were very common on the birch in the Platte Canyon, more especially higher up, at an altitude of 7,000 feet; also on the foothills back of Golden at a similar altitude. The birches were often completely defoliated by the larvæ, except for the leaves which served to support the cocoons, though these were often distributed over

¹Professor Fernald identifies this species with the European *O. diana*. I have seen but two specimens of this rare species, and both differ from the American form, of which I possess now a large series. Our moths are very dark, with no trace of the greenish overlying scales of the European ones. They may, perhaps, be separated under the varietal name *betuliperda*.

neighboring low plants. At the Half Way House on the Pikes Peak Railroad, at a similar altitude to the places where this species occurred so abundantly farther up the range, no specimens were seen and the birches were uninjured. The species, therefore, seems to be local in its appearance. Prof. C. P. Gillette spoke to me of this species as one that he had long observed to be destructive to the birch.

The larva lives under a delicate web which it spins over the surface of a leaf, held above the surface by the curl of the leaf. It eats the parenchyma on the upper side, skeletonizing the leaves, which become brown and dry.

CEROSTOMA RUBRELLA Dyar.

Larva.—Flattened, the dorsal section rounded triangular, strongly tapering at both ends. Head small, elongate, held nearly flat, with broad high clypeus, vertex under joint 2; pinkish, mottled over the lobes with large, pale brown spots; clypeus and epistoma, with antennæ and anterior thoracic feet whitish, somewhat mottled; ocelli and tips of antennæ dark; width 1 mm. Body thickest at joints 5 and 6; shields nearly concolorous, not contrasted. Slate gray, dorsal line yellowish brown, pale yellow edged, a little irregular and clouded, faintly cutting the cervical shield, which is pinkish gray, edged with neat black tubercles; stigmatal fold obscure, faintly shaded in yellowish and brown. Feet normal, pale. Tubercles small, black, distinct, whitish ringed; iv and v separate, iv a little dorsad; on joint 3 ia and ib approximate, separate on joint 4; iia + iib, iv + v. Setae distinct, brownish. A few white lateral dots and some stigmataly; segments obscurely about 6-annulate.

Solitary on the backs of the leaves, perfectly exposed and spinning no web; on *Berberis repens*, Boulder Creek Canyon; also in other canyons, but less commonly. Larvæ active, jumping off the leaves when disturbed.

The moths resemble the European *Cerostoma radiatella* Donovan, which has been recorded also from America. They are similar in shape and size, and are like one form of that variable species in coloration. But they are not variable, my 12 specimens being absolutely uniform, besides which the larva and food plant are different. I have, therefore, thought them deserving of a distinct name.

Palpi clothed with black and a few white scales, longer at the end of the second joint; face black and white scaled; vertex with long red brown vestiture, basal joint of antennæ and neck narrowly white; antennæ white and black banded below. Thorax and fore wings above smooth red brown with bronze reflection, an obscure lighter ray from the base along the submedian vein, distantly edged above with a few black scales which are more distinct on the outer half of the wing. Abdomen and hind wings silky blackish, as are all the wings below, the costa of fore wings only narrowly pale. Legs and abdomen below pale gray, shining. Expanse, 14 mm.

Family GELECHIIDÆ.

GNORIMOCHEMA COQUILLETTELLA Busck.

Larva.—Head rounded, elongate, vertex under joint 2, clypeus triangular, high, not reaching vertex; ocelli black, jaws brown; width 0.8 mm. Body somewhat flattened, incisures distinct, segments faintly 3-annulate; cervical shield reduced, the front part membranous; anal plate large, shining. Skin transversely wrinkled. Tubercles moderate, shining, but weakly cornified, i slightly dorsal to ii, iv + v; ia and ib nearly separate, iia and iib confluent, iv + v. On abdomen the upper seta of iv + v is anterior and smaller. Feet normal, short, the crochets in a small, complete circle, all pale. Setæ moderate, pale. Color sordid yellowish or whitish, head pale testaceous, sutures brown, ocelli black.

The larvæ form false galls on the terminal twigs of *Bigelovia*. The terminal leaves of a young growing tip become united into a fusiform gall-like enlargement, forming a tight box. Every leaf or part of one that touches the inside of the cavity of the box is swollen in that part of its surface; the swollen parts become yellowish and the leaves adhere together, forming the four or five sided box. The tip of the stem bearing the box is recurved. Larva within the hollow, destroying the bud. Frass in the pointed tip. These curious formations, looking like large flower buds, were found commonly in a few places in the Platte Canyon and on the prairie near Denver. When occurring at all, they were generally abundant. They were not found, however, until too late in the season to be successful in rearing the moths. Still, they seem obviously to be the same as the species described by Mr. Busck.

As Mr. Busck's paper on the Gelechiidæ, in which his description would naturally appear, is delayed, I have asked him to furnish the description in advance, which he has kindly done. I append it.

GNORIMOSHEMA COQUILLETTELLA Busck, new species.

Antennæ dark brown with narrow silvery white annulations. Labial palpi of typical *Gnorimoschema* form; second joint whitish sprinkled with brown scales and with a black bar on the outside; terminal joint black with a white annulation around the middle. Face whitish; head and thorax whitish, heavily overlaid with dark fuscous. Forewings with basal fifth light yellowish brown, which color is continued outward and downward in a tapering curved streak along dorsal edge to beyond middle of the wing. The ground color in the rest of the wing is pale bluish white with each scale tipped with black. Adjoining the basal fawn-colored area is a semi-circular costal region, heavily overlaid with dark fuscous, and outside this is another similar costal dark area not so well defined. In the first of these dark semicircles, on the middle of the cell, is a dark reddish-brown dot, surrounded by a few fawn-colored scales, and below the second costal semicircle, at the end of the cell, is another similarly edged spot. A few dark fuscous scales are sprinkled irregularly

over the apical part of the wing, and the extreme apex is dark fuscous. Hind wings silvery fuscous, darkest along costa and toward the tip; cilia yellowish. Abdomen dark silvery fuscous; legs whitish, shaded with dark fuscous.

Alar expanse 11.5 to 14 mm.

Habitat.—California.

Food plant.—*Applopappus pinifolius*.

Type.—No. 6288, U.S.N.M.

Described from many specimens bred by Mr. D. W. Coquillett and Mr. A. Koebele, from thin-walled oblong galls, formed by the undeveloped bud of *Applopappus pinifolius* near Los Angeles, California.

ANACAMPSIS INNOCUELLA Zeller.

Larva.—Head rounded, flatly outstretched, vertex under joint 2; black or brown with black sutures. Body normal, scarcely flattened, a little smaller at the ends. Cervical shield slightly rugose, brown and black behind and at the sides, shading to whitish before. Skin transparent, appearing white from the fat, food obscurely green; dorsal vessel dark. Tubercles moderate, rounded, black, ia+ib, iia+iib, iv+v. Thoracic feet black; abdominal ones normal, short; no anal plate.

The larvæ occurred as leaf rollers on the broad-leaved cottonwood (*Populus fremontii wislizeni*) at Denver. The leaf is neatly rolled to several turns, forming a remote spiral, held with cross bands of silk throughout. The end is open, and the larva can be seen in the center. Sometimes several leaves are involved.

NEALYDA BIFIDELLA Dietz.

Larva.—Head small, flat, clypeus rounded triangular, reaching the broad, membranous, vertical triangle, mouth small; pale luteous, sutures of clypeus brown, ocelli small, black. Body moderate, flattened, joint 2 smaller than 3, 4 and 5 equal, then slightly enlarged to the middle of abdomen and a little tapering to end. Segments angularly projecting laterally posteriorly; joint 13 small, divided, the posterior half abruptly smaller. When retracted the segments are flattened moniliform. Thoracic feet small, slender, wide apart; abdominal ones on joints 7 to 10 like slender papillæ, with a spoon-shaped enlargement at tip, in shape much like the thoracic feet, without hooks; no feet on joint 13. Translucent pale yellow, whitish pedally; joint 2 dorsally and ventrally shagreened; no shields. Setae iv and v distinct, remote, in line, v smaller and just below the spiracle, iv posterior; vi rather distinct, but dorsal setæ obsolete.

Living in blotch mines under the upper epidermis of the leaves of *Allionia nyctaginea*, the mine nearly reaching through to the under surface; small for the size of the larva, the frass gathered in a bunch at the end. Found at Salida July 25; moth August 8.

GELÈCHIA RIBESELLA Chambers.

Larva.—Head rounded, mouth large, projecting, clypeus high; greenish luteous, shining, faintly brownish mottled, ocelli black in an aggregated patch. Body cylindrical, normal, segments 3-annulate; green, a not very bright, white, subdorsal line; shield large, faintly luteous. Tubercles small, without plates, black; ia and ib separate, ii+iii, iv+v. On abdomen iv+v, but not on a common shield; i to iii are distinct, showing as black dots, the rest smaller. Setæ moderate, brownish. Feet all pale.

In spun-up leaves on *Ribes cereum* at Bailey's, in Platte Canyon, July 13; imago July 18.

GELECHIA UNCTELLA Zeller.

Larva.—Head rounded, vertex under joint 2; pale luteous, ocelli black. Cervical shield whitish, immaculate. Body slender, tortriciform, whitish with even purplish-brown bands as wide as the spaces between; subdorsal, lateral, substigmatal with a faint cloud subventrally. Feet all pale. Tubercles minute, setæ fine; spiracles dark. A faint, broken, medio-ventral dark band. Anal plate small, pale. Tubercles iv and v approximate, v dorsal. Tubercles dark, without plates.

Webbing up the leaves, often gregarious, forming a large mass of web and leaves in a ball; on *Lupinus* and *Thermopsis montana* at Boulder Creek Canyon and foothills back of Golden.

GELECHIA PRAVINOMINELLA Chambers.

Larva.—Head pale luteous, shaded over vertices of lobes with reddish; ocelli black. Shields and anal plate pale, translucent, luteous tinted. Body opaquely whitish; subdorsal, lateral and suprastigmatal, blotched, irregularly edged, dull purple bands, leaving the small black tubercles in the pale parts. Tubercles ia and ib separate, ii+iii and iii+iv approximate, iv+v, v very small. A trace of subventral purplish shadings. Setæ moderate, pale. Feet normal, short, green.

The larva folds a young leaf of the aspen with web which reaches down to the petiole and stem, broad, band-like, and cobwebby. It forms a tube within the folded leaf. Found at Pine Grove in the Platte Canyon July 9. Moth emerged July 22.

GELECHIA ANARSIELLA Chambers.

Larva.—Head rounded, apex in joint 2, shining black, labium and epistoma pale. Body rather thick but flattened. Cervical shield large, black, all of joint 2 black, joint 3 vinous black except in front which, with joint 4 in front, is narrowly but conspicuously collared in bright white. Rest of body green, faintly brownish shaded to the spiracles, then clear green; a faint, broad, whitish subdorsal line

along tubércles i and ii. Thoracic feet black; a faint whitish dorsal line; anal flap whitish, dark punctate before. Feet normal, green. Tubercles black, white, ringed; ia and ib separate, iia+iib, iv+v, v small.

Larvæ on *Ceanothus*, spinning a delicate web over the leaf it is feeding on, hiding in a silken tube in a folded leaf or between leaves. Found at top of Chimney Gulch, Golden, July 9; imago July 20.

GELECHIA VERSUTELLA Zeller.

Larva.—Head pale testaceous, sutures about clypeus, paraclypeal pieces and bases of lobes more or less black shaded. Body moderate, tortriciform, green, with a distinct pale subdorsal line; sides somewhat fluted. Tubercles minute, setæ moderate, white, iv and v united. Feet normal, short; head setæ long, white. When mature the larva becomes shaded with pink and enters a place of concealment to transform.

Found in folded leaves on the cottonwood at Denver, May 31. Moths out June 26.

GELECHIA OCELLELLA Chambers.

Larva.—Head rounded, bilobed, oblique, apex under joint 2 when retraced; luteous brownish mottled, sutures narrowly nearly black, or the head all shining black; epistoma scarcely paler. Cervical shield black with a pale dividing line and luteous patch in each half, or the patch merely a narrow, somewhat impressed dash. Green, dorsum all shaded in purplish; narrow dorsal, broader subdorsal, fainter and slightly broken lateral and stigmatal whitish bands; joints 3 and 4 green dorsally in the incisures. Tubercles pale, concolorous, hair tubercles black; normal, iv+v, ia and ib separate, iia+iib. Body normal, the incisures depressed. Feet of joints 2 and 3 black, or pale, black tipped. Abdominal feet green.

Found in folded or cut leaves, slightly webbed, on the poison ivy (*Rhus toxicodendron*), in the Platte Canyon July 3; imago July 19

Family TINEIDÆ.

GRACILARIA PNOSMODIELLA Busck.

Larva.—Head moderately flattened, bilobed, clypeus band-shaped but narrowed to a rounded point at the vertical triangle; pale luteous; mouth and sutures brown. Body nearly cylindrical, segments angularly moniliform, no shields. Tubercles and setæ both pale, somewhat developed, several visible even dorsally. Thoracic feet short, obliquely extended; abdominal on joints 7 to 9 and 13, sessile, with a little bunch of hooks. Dorsum and venter of joint 2 shagreened. All pale yellowish, no marks. Segments subequal, the center of the abdomen a little enlarged.

Mining in the leaves of *Pnosmodium carolinianum* on the prairie at Golden near the foothills. A large blotch mine under the lower epidermis, the upper side a little swollen and yellow. Finally the leaf becomes brown and dead on both sides. Imago July 26. The moths proved to belong to an undescribed species, but Mr. Busck has prepared the following description which is submitted in conjunction with my note on the larva:

GRACILARIA (DIALECTICA) PNOSMODIELLA Busck, new species.

Antennæ as long as fore wings, simple, dark bronzy with indistinct, narrow, white annulations; basal joint without pecten, whitish. Labial palpi silvery white, somewhat loosely scaled beneath toward apex. Maxillary palpi distinct, porrected, silvery white. Fore wings shining coppery golden with silvery white markings edged with black. At basal third is an oblique white costal streak reaching down to the fold, where it bends outward and is prolonged somewhat along the fold; between this and the apex are three equidistant triangular, white, costal spots; the first at middle of wing, the second at the beginning of the costal cilia, and the third in this cilia. Opposite the intervals between these three costal spots are two dorsal, white, triangular spots, and the base of the dorsal edge is white. All these white markings are sharply edged by thin black lines. Dorsal cilia golden, apical cilia white, a short, perpendicular black cross line. Under side of thorax silvery white; legs white with broad black annulations; spurs white; posterior tibiæ pectinated above. Abdomen shining dark purple, with broad white transverse bands on the under side; anal tuft white.

Alar expanse 8 to 9.5 mm.

Habitat.—Colorado (Dyar).

Food plant.—*Pnosmodium carolinianum*.

Type.—No. 6267, U.S.N.M.

This beautiful and singularly marked species may fall in Lord Walsingham's genus *Dialectica*¹ when the group to which it belongs has been critically worked up. *Dialectica* is distinguished from *Gracilaria* by the pectinated posterior tibiæ. It is nearest and very similar in ornamentation to *Coriscium albinatella* Chambers,² but is easily separated by the pure white palpi, by the first costal streak which does not reach down to the white basal part of the dorsal edge, and by several smaller differences in ornamentation.

GRACILARIA THERMOPSELLA Chambers.

Larva.—Head flat, rounded, broadly bilobed at vertex, clypeus triangular, reaching the vertical triangle; smoky luteous, translucent, ocelli black; half retracted in joint 2. Joint 2 flattened dorsally, projecting at the sides, without distinct shield. Segments nearly equal, 4 and 5 a little smaller, tapering a little behind, 13 suddenly smaller, slender, divided. Body behind joint 2 nearly cylindrical, submoniliform, segments dented subannulate; shining, pale greenish yellow without marks. Setæ nearly obsolete, a few pale ones on the sides. Feet on joints 7 to 9 and 13 with a bundle of hooks directed backward, not in a definite ellipse. Thoracic feet moderate, directed downward.

Leaf miners in *Thermopsis montana* under the upper surface, the

¹Proc. Zool. Soc. Lond., 1897, p. 150.

²Can. Ent., IV, 1872, p. 25.

frass pushed out through a hole below. The larvæ readily emerge from the mine and start a new one in another leaf, entering by a slit which they make on the under side. The mature mine is a large, lobed hollow under the upper epidermis. The young mines are long and tortuous, on the under side, not widening. Found at Baileys in the Platte Canyon July 13. First imago July 25.

LEUCOPTERA ALBELLA Chambers.

Larva.—Head flat, rounded, a band-shaped clypeus, narrowed a little above; whitish, two black ocelli visible on the upper aspect, three on the lower; mouth small pointed, the brown mandibles small, normal. Body slender, flattened, laterally moniliform; joints 2 and 3 larger than 4 and 5, 6 to 10 again a little larger, subequal, 11-12 and 13 tapering, 13 divided, but the segments of equal width. Cervical shield present as a slightly wrinkly area but perfectly concolorous, whitish. Male glands large, filling the whole dorsum of joints 9 and 10, yellowish faintly, segmented. Thoracic feet very short, appressed, projected laterally but not exceeding the edge of the body. Abdominal feet sessile on joints 7 to 10, those on joint 13 a little larger. Venter of joint 2 subcornified, the feet almost rudimentary. White, no marks, no visible setæ.

Leaf miners in the narrow-leaved cottonwood at Morrison and on the foothills back of Golden. A large, black, blotch mine under the upper epidermis, eaten through continuously to the lower epidermis, making a large dead area in the leaf. Several larvæ in each mine, feeding side by side. Frass contained. The larvæ were very abundant where they occurred, nearly destroying all the leaves on large trees, though the individual larva is so minute. When they spun, the remaining leaves of the tree and adjoining foliage were spotted with their white cocoons, covered over by cross bands of silk. First found June 28, by Mr. Caudell.

LITHARIAPTERYX ABRONIÆELLA Chambers.

Larva.—Head small, the apex in joint 2, rounded, clypeus triangular, touching the vertical triangle; sordid luteus, mouth brown, sutures of clypeus brownish, ocelli black; labium large. Cervical shield brown, bisected into two triangles, the edge dotted by black tubercles. Body slender, cylindrical, segments submoniliform and almost equal, slightly tapering at the ends. Not shining, rather opaque pale green; tubercles small, black; ia+ib, iia+iib, iv+v on thorax; on abdomen, i dorsad to ii, iv and v remote, iv perceptibly dorsad, vi normal. Segments biannulate, the subventral fold rounded, prominent. No marks.

The pupa is flattened, resembling a seed with a wing-like margin. It is green at first, but soon turns brown. The larvæ form variously

shaped blotch mines, with a hole by which the frass is extruded; they also spin among the terminal leaves or flower bracts with a delicate web in which the frass is contained. The food plant is *Allionia nyc-taginea*. Larvæ from Salida July 25. First imago August 4.

LITHOCOLLETIS CINCINATIELLA Chambers.

Larva.—Strongly flattened, the segments projecting roundedly laterally; joint 2 large, 3 smaller, then gently enlarged to the center and tapering to end. Dorsal and ventral plates the whole length, subcorneous, nearly colorless. No feet; black spots in place of the thoracic feet, and dark scars on joints 7 to 9 and 13. Dorsal marks on joints 2 to 4 just like the ventral foot scars. Head triangular, very pointed, the mouth widened by the transverse, projecting labrum; ocelli black, one remote above the others; palpi projecting nearly at right angles; clypeus band shaped, broadened above, edged by the parallel paraclypeal pieces; pale luteous, sutures and mouth black. Body whitish, purple dotted on the sides of the segments, dark orange on the sides of joint 2 and anterior half of joint 3. A dorsal and ventral diffuse purplish shade, not quite reaching the ends.

The mine is large, 30 mm. or more in length, flat, slightly ribbed; several larvæ in a mine. Found on oak at Manitou. Usually the oaks were not infested with leaf miners, but this place proved an exception. The species were, however, members of the Atlantic Coast fauna. *Lithocolletis basistrigella* Clemens, *L. fitchella* Clemens, and *Tischeria cincipennella* Clemens were the other species occurring on the oaks at Manitou.

LITHOCOLLETIS SALICIFOLIELLA Clemens.

Larvæ in elliptical blotch mines under the lower epidermis, white, finally eating through to the upper epidermis in dots and patches, usually mostly so about the edges; mine about 17 by 9 mm.; a slight fold down the long diameter. Singly or, rarely, two on a leaf.

Larva.—Head cordate but only very slightly lobed, clypeus high, band shaped, but narrowed to a point where it touches the vertical triangle, whitish, the sutures and a diffuse shade on lateral margin brown; a black speck with a smaller one within on the face of each lobe; several black specks on the ventral aspect of lobe; antennæ small but distinct. Body arched above, gently flattened below, moniliform, joints 3 and 4 larger than 2, 5 small, then gradually larger to 9 and gradually smaller to 13, which is scarcely divided and not sharply smaller. Cervical shield weak, concolorous. Joints 2 to 6 white, 7 to 12 yellow, with large, rounded, brown-black dorsal spots, flattened posteriorly; dark ventral spots on joints 6 to 12 and a faint one on joint 5; joint 13 somewhat translucent, luteous above and below. Thoracic feet large, projected laterally, exceeding the body, well jointed;

abdominal ones sessile, represented on joints 7 to 9 by a bunch of crochets behind and a single row before each planta; on 13 a more distinct foot, with double row of crochets broken on the inside and outside. No feet on joint 10. *Setæ* long, brownish, from small, distinct tubercles; ia and ib in a group; ib larger; iia and iib somewhat anteriorly placed, iib large; iv and v present. On abdomen i and ii nearly in line, ii larger; iii above and a little behind the small, anteriorly situated spiracle; iv below and well behind; v and vi obsolete. Subprimary tubercles all absent, apparently by reduction. No ventral *setæ*. Skin finely granular, shagreened, not distinctly so.

Younger larvæ were all colorless, the head the same but with black ocelli at the edge. Anal end well rounded, the segments subequal throughout. *Setæ* apparently the same.

The cocoon is elliptical, 7.5 by 4 mm., formed in the center of the mine. Mines in the broad-leaved cottonwood in Denver. Imago July 2.

A REVIEW OF THE CLING-FISHES (GOBIESOCIDÆ) OF THE WATERS OF JAPAN.

By DAVID STARR JORDAN and HENRY W. FOWLER,
Of the Leland Stanford Junior University.

In this paper is given an account of the *Gobiesocidæ*, two in number, known to inhabit the waters of Japan.

Family GOBIESOCIDÆ.

CLING-FISHES.

Body rather elongate, tadpole-shaped, broad and depressed in front, covered by smooth, naked skin; mouth moderate; upper jaw protractile; teeth various, sometimes villiform, sometimes incisor-like, and posterior canines sometimes present; suborbital ring wanting; no bony stay from suborbital across cheek; opercle reduced to a spine-like projection concealed in the skin; behind the angle of the large preopercle this spine sometimes obsolete; palatine arch considerably modified; pseudobranchiæ small or wanting; gills 3 or $2\frac{1}{2}$; gill-membranes broadly united, free, or united to the isthmus; dorsal fin on the posterior part of the body, opposite to the anal and similar to it, both fins without spines; ventral fins wide apart, each with 1 concealed spine and 4 or 5 soft rays. Between and behind the ventrals is a large sucking disk, the ventrals usually forming part of it. No air-bladder; intestines short, pyloric caeca few or none; skeleton firm; vertebrae 13 or $14+13$ to $22=26$ to 36.

Carnivorous fishes of small size, chiefly of warm seas, usually living among loose stones between the tide marks and clinging to them firmly by means of the adhesive disk. Their relations are obscure, but they are probably descended from allies or ancestors of the Trachinidæ or Batrachoididæ.

- a. Lepadogasterina.* Gill-membrane attached to the isthmus; posterior part of the sucking disk with a free anterior margin.
b. Gills $3\frac{1}{2}$; each jaw with one row of conical teeth; dorsal and anal with very short, well-developed rays *Aspasua*.

ASPASMA Jordan and Fowler.

Aspasma JORDAN and FOWLER, new genus (*minimus*).

Body moderately broad, depressed anteriorly; snout prominent, depressed, suggesting the bill of a duck; jaws with rather strong, conical teeth in one series in each jaw; gills $3\frac{1}{2}$; pseudobranchiæ rudimentary; branchiostigals 5; gill-membranes attached to the isthmus; anterior margin of sucking disk free, the posterior part attached to the shoulder girdle; dorsal and anal short, with well-developed rays, both fins well separated from the caudal; no scales.

Small fishes of the warm seas of Japan, apparently closely allied to the *Lepadogaster*¹ of the Mediterranean, but the latter has longer fins (D. 15 to 18; A. 8 to 14) and a different dentition, the very small teeth being in a patch in each jaw, and one row on the scales. In *Mirbelia bimaculata*, which has also very short fins, the teeth are in a villiform patch anteriorly, as in *Lepadogaster*. The genus *Mirbelia* was originally proposed for those species of *Lepadogaster* which have the caudal free from the dorsal and anal.

(ἄσπασμα, an embrace.)

- a. Dorsal rays 6; anal rays 5; depth 7 in length; last ray of dorsal and anal not adnate to caudal peduncle *minima*, 1.
 aa. Dorsal rays 10 to 12; anal rays 9; depth $5\frac{2}{3}$ in length; last ray of dorsal and anal adnate to caudal peduncle *ciconia*, 2.

1. ASPASMA MINIMA (Döderlein).

Lepadogaster minimus DÖDERLEIN, in Steindachner, Fische Japans, IV, 1887, p. 270; Sagami Bay in 100 to 150 fathoms.

Head $3\frac{1}{2}$; depth 7. D. 6; A. 5. Body, elongate, much compressed below in front, and the laterally compressed posteriorly. Head rather long, broad, compressed, and its breadth $1\frac{3}{8}$ in its length; snout depressed, rather pointed, about 4 in the head, and 1 in the interorbital space; eyes small, lateral, 4 in the head and about equal to the snout; interorbital space, together with the upper part of the head, broad and flat; mouth with the jaws about equal and the maxillary reaching the eye. Gill-openings lateral, directly in front of the pectoral, and the isthmus very broad across; origin of the dorsal nearer the base of the caudal than the tip of the pectoral; anal very slightly behind the origin of the dorsal, the posterior edges of both fins nearly even, leaving a free caudal peduncle; pectorals very broad, short, rounded, and nearly $1\frac{3}{8}$ in the head; disk rounded, its edge entire and about $1\frac{1}{3}$ in the head; caudal short, rounded, and nearly $1\frac{3}{8}$ in the head; caudal peduncle free, strongly compressed, and its depth equal to the interorbital space.

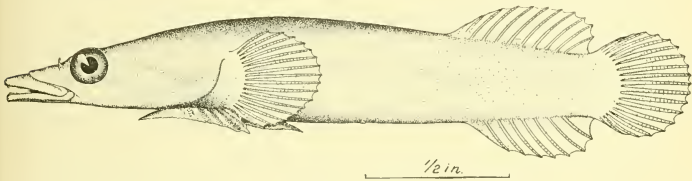
¹Gouan, Hist. Pisc., 1770, p. 177, *rostratus*.

Color in alcohol uniform lemon-yellow. Described from a specimen from Misaki about $1\frac{5}{16}$ inches long.

This little fish is known to us from two examples from tide pools at Misaki near the original locality from which the species was described. (*minus*, smallest.)

2. *ASPASMA CICONIÆ* Jordan and Fowler, new species.

Head $2\frac{3}{4}$ to 3; depth $5\frac{1}{2}$ to $5\frac{2}{3}$; D. 11 or 12; A. 9; P. 20; V. 4. Body elongate, much compressed anteriorly below so that it is more or less flattened; back convex. Head rather broad, its breadth about $1\frac{1}{2}$ in its length; snout depressed, rather pointed, about $3\frac{1}{3}$ in the head, flattened, and its length three-fourths its breadth; eyes small, lateral, about 5 in the head, $1\frac{2}{3}$ in the interorbital space, and $1\frac{2}{3}$ in the snout; interorbital space broad and flat; mouth broad, the maxillary reaching the eye; lips rather thin and broad; teeth sharp and in a single series in each jaw; gill-openings lateral, directly in front of the pectoral, and



ASPASMA CICONIÆ.

the isthmus very broad across. Origin of the dorsal nearer the tip of the pectoral than the base of the caudal, and its last ray united to the caudal peduncle by a membrane; anal beginning behind the origin of the dorsal, its last ray even with the last dorsal ray and also adnate to the caudal peduncle by a membrane; pectorals broad, rounded, and short; disk rounded, its edge fringed, about $1\frac{1}{3}$ in the length of the head; caudal short, rounded, and a little greater than the pectoral; posterior portion of the body compressed laterally so that the depth of the caudal peduncle is equal to the interorbital space.

Color in alcohol uniform pale brown with a red tint behind the eyes and on the caudal. This description from two examples from Wakanoura, measuring $2\frac{3}{8}$ and $2\frac{1}{2}$ inches respectively.

This species is distinguished from *Asparma minima* by the ends of the dorsal and anal reaching the caudal and thus their bases are upon the caudal peduncle; it also differs in the larger number of fin rays.

Our specimens from the tide pools, near Wakanoura, No. 7136, Leland Stanford Junior University museum.

(*ciconiæ*, of the Stork, in allusion to the bird for which this picturesque "Bay of Romantic Song" was once famous. The poem "Over Waka-no-ura¹ the storks fly a crying," etc., is well known in Japan.)

¹ Waka-no-ura ni
Shio michi kureba
Kara wo nami
Ashebe wo sashite
Tazu naki-watara.

Translated literally:

On the shores of Waka
When the tide flows in,
Dry land being none,
Toward the place of reeds
The storks fly crying.

OBSERVATIONS ON THE CRUSTACEAN FAUNA OF NICKAJACK CAVE, TENNESSEE, AND VICINITY.

By WILLIAM PERRY HAY,
of Howard University, Washington City.

I.—INTRODUCTION.

During the summer of 1901 the writer was able to visit Chattanooga, Tennessee, for the purpose of examining certain caverns in that region and making collections of the crustacean fauna. Like most other parts of the country in which limestone abounds, the region is full of caves, some ten or more being easily accessible from Chattanooga. Of these only a few have been visited by collectors. Owing to lack of time the writer was forced to pay attention only to the better-known caves, a brief description of which follows.

Nickajack Cave is situated near Shellmound, Tennessee, a small station on the Nashville, Chattanooga, and St. Louis Railroad, about 20 miles southwest of Chattanooga; it may also be located about one-fourth of a mile north of the point where the south line of Tennessee is joined by the boundary line between Georgia and Alabama. Here is also the end of Sand or Raccoon Mountain, a long ridge, which for many miles separates the drainage basin of the Tennessee River from that of the streams which flow into the Gulf of Mexico, a broad, flat-topped ridge with a foundation of limestone and a superstructure of the sandstone. It rises rather abruptly from the narrow river valley to a height of over 1,700 feet.

The mouth of the cave, which by the removal of a few trees has been made easily visible from the railroad, lies at the base of the north point of Sand Mountain, and the passage seems to extend straight back along the axis of the ridge. In size and impressiveness the entrance far surpasses that of any other American cavern, and alone should make Nickajack a point of interest. It is about 200 feet wide and 75 feet high from the surface of the cave stream to the ceiling. About half the width is taken up by the gorge through which the stream flows; the remainder

is filled to a height of probably 50 feet with a mass of clay and rocks. The mouth of the stream is obstructed with great masses of rock, which make entrance at that point almost impossible. Taking the path on the left-hand side of the entrance, the visitor follows close



SKETCH MAP OF NICKAJACK CAVE.

- a* Wagon road crossing cave stream.
- b* Pool in front of cave.
- c* Entrance.
- d* Large stalagmite.
- e* Valley in which are two stalagmites.
- f* Labyrinth of small passages.
- g* Bank of large blocks of rock.
- h* Side passage with branches parallel to main cave.
- i* Side passage about 25 feet above level of stream.
- j* Wall of rock apparently ready to fall.
- k* Mass of rocks obstructing cave stream.
- l* Pool at limit of exploration.
- m* Possible continuation of passage.

to the wall for a distance of about 100 yards to the brink of a steep hill. Here the path divides, one branch leading down the hill to a flat floor only a few feet above the stream; the other still follows the wall and soon enters a crevice, which, in turn, leads to a labyrinth of low, tortuous passages. From the labyrinth one may return to the main cave again by a rough climb over a great heap of fallen stone, the exit being into an enormous room 100 feet wide and long, and 60 feet high, in which hundreds of bats have congregated. From this room the path leads down the side of the rocky hill to the water's edge and joins the other branch of the original path, which was left on the right on entering the labyrinth. From here on the cave is much smaller, the width has decreased to about 30 feet and the ceiling is little, if any, over 20 feet high. The cave stream so nearly covers the floor that one must walk close to the wall and from time to time cross the stream to find a path on the mud banks, which border it first on one side and then on the other. If one does not object to getting wet it is thus possible to penetrate probably over half a mile into the recesses of the cave to a great room, 80 to 100 feet in diameter and with a ceiling 60 or 70 feet above the water. The stream here runs through a gorge made still more narrow by the fallen stone, which lies as if thrown down by some great convulsion

of nature and seems ready to take another tumble if disturbed to the slightest degree. At one place the rock masses have blocked the stream so effectually that it is impossible to get a boat around them, and beyond is a large pool too deep to cross by wading. This room is practically

the limit of exploration; but that the cave, probably as a large and easily traveled passage, goes much farther there can be but little doubt.

There is evidence on every hand that the cave is very old, and is now in its period of decline. There are no stalactitic formations of importance except at a point about 100 yards from the entrance where there is a large mound-like stalagmitic growth 6 or 8 feet high and perhaps 20 feet in diameter. In a series of pockets or basins on this stalagmite were found large quantities of "cave pearls," rounded concretionary masses of lime which had formed in the disturbed water without becoming attached to the sides or bottom. In several places in the cave there are immense heaps of loose rock piled from the floor to the ceiling, and in some cases large blocks seem to have fallen quite recently.

The cave stream, which has been already mentioned, flows through the entire length of the cave, so far as it is known, and is of practically uniform size and depth throughout. It receives no tributaries, but makes its appearance in the large pool at the end of the cave, apparently boiling up from beneath the rock wall, and flows toward the mouth of the cave with a good current. It is bordered first on one side and then on the other by mud banks, the side next to the bank being shallow, while the side next to the rock wall will average 3 or 4 feet in depth. The large pool just mentioned seems to be quite deep, but as it was not possible to launch a boat upon it it was also impossible to sound it.

Two visits were paid to the cave, each extending over several days. At the time of the first visit, heavy rains having recently fallen, the water in the cave was so high as to preclude the possibility of collecting. The net result of six days work was a single pair of blind crayfish. The second visit, some ten days later, was more successful, as, the water having subsided, it was possible to get from one part of the cave to another and to work in the stream itself.¹

Less famous than Nickajack Cave, but at the same time widely known, is a rather small cavern known as Lookout Cave, which runs for some distance back under Lookout Mountain. The entrance is reached from the Nashville, Chattanooga, and St. Louis Railroad tracks not over a mile from Chattanooga. The passage a short distance from the entrance becomes quite narrow, but a little farther on widens and becomes higher so that it is quite commodious. The route gradually descends to the level of the river outside and at last meets a small subterranean stream along which one can wade for some distance in either direction. I was able to visit this place but once and then found the water too muddy for successful collecting. In one deep hole, however, I saw a very pale-colored salamander about 15cm in length. It may have been a larval form of some out-of-door species, but it looked

¹Cope and Packard, *The Fauna of the Nickajack Cave*, *American Naturalist*, XV, 1881, p. 880.

quite unlike any with which I am familiar. It swam away with such rapidity when I attempted to secure it that it soon disappeared in the muddy water.

At Rossville, Georgia, I was able to penetrate a few feet into a small cave at the "John Ross Spring." At Shellmound I paid two visits to what is known as the Wine-house Cave, a treacherous hole of 85 feet almost perpendicular depth, filled with loose rock masses of all sizes. The passage at the bottom of the cave is very short, but contains several pools of water which will probably be found to contain about the same fauna as the stream in Nickajack Cave.

During the interval between the two visits some collecting was done at Rossville, Georgia, and in the immediate vicinity of Chattanooga. The results of that work are included in this report.

II.—REMARKS ON ANIMALS, OTHER THAN CRUSTACEA.

In addition to the light-colored salamander mentioned above I observed several other animals, which may be referred to here, as they will not find a proper place in the body of the paper.

In the Wine House Cave I saw a small white fish which, from its actions, I took to be a blind species, but it was quite unlike *Amblyopsis* and may belong to some unknown species. Here also I secured one specimen of the cave salamander, *Spelerpes maculicauda*.

In Nickajack Cave there were hundreds of bats, and in their dung, which covered the floor and rocks in some places to a depth of several inches, I found numerous small Lepidopterous insects in appearance very like the ordinary clothes moth. Cave crickets (*Hadenovus subterraneus* Scudder) were common, but nowhere abundant. In the stream I noticed a few small minnows and many blobs (*Cottus* sp.). Here I also found a good-sized water snake (*Natrix* sp.) swimming about in a most confused manner. A day or two later I found a butterfly *Neonympha gemma* perched upon the wall of a narrow and totally dark side passage. The snake and butterfly were undoubtedly accidental visitors to the cave. The others, with perhaps the exception of the blobs and minnows, were permanent inhabitants.

III.—CRUSTACEA.

Suborder ISOPODA.

Family ASELLIDÆ.

Genera MANCASELLUS Harger and CÆCIDOTEA Packard.

CÆCIDOTEA Packard.

While in this paper and a preceding one¹ I have used the name *Cæcidotea* for the eyeless subterranean Asellidæ, I have done so

¹ Observations on the Crustacean fauna of the region about Mammoth Cave, Kentucky. This volume, p. 223.

unwillingly, more out of deference to common usage than out of confidence in the validity of the genus. The case has been several times reviewed by various writers, but in view of the fact that in this paper several new facts regarding the species are brought forward I feel warranted in presenting a complete digest of all that has been said and adding thereto such remarks as my experience dictates.

The genus *Cecidotea* was erected in 1871 by Dr. Packard for the reception of the peculiar eyeless Isopod from the cave region of Kentucky. The original diagnosis was based on imperfect specimens which lacked the uropods and second antennæ, and the name *Cecidotea* was intended to call attention to its affinity to the marine genus *Idotea*. However, a careful comparison of the structural details with this genus and with *Asellus communis* showed that these first ideas were erroneous and that the affinity lay with *Asellus* rather than *Idotea*. As the genus *Asellus* is a characteristic fresh-water form distributed in North America, very generally throughout the fresh-water surface streams and ponds of the cave region, the probable very close relationship of the two genera *Cecidotea* and *Asellus* and the probable descent of the blind form from the other became apparent. In 1876 Dr. S. A. Forbes¹ united it with *Asellus*, and in describing his investigations said "A detailed comparison of this species with undoubted *Asellus*, especially with the admirable plates of *A. aquaticus* in the 'Crustacées d'eau douce de Norvege,' has failed to reveal any structural peculiarities which could positively serve as the characters of a distinct genus." In 1881 Dr. Packard described a second species of this genus from Nickajack Cave, near Chattanooga, Tennessee, calling it *Cecidotea nickajackensis*. At the same time he stated his opinion that the two species of *Cecidotea* had sprung from two distinct species of *Asellus*. Five years later the same author, in his monograph of the Cave Fauna of North America,² defends his genus, and this defense has apparently been sufficient to cause all subsequent writers to accept it. He says:

It remains to be seen, however, whether Mr. Forbes has not somewhat overstated the case and whether there are not a number of structural peculiarities which forbid our placing the two known species in the genus *Asellus*. It should be observed that not only are *Cecidotea stygia* and *Cecidotea nickajackensis* without eyes, but that the body and appendages also differ a good deal from any of the known species of *Asellus*. The genus seems as well founded as many others in the Isopods and other groups of Crustacea. We have little doubt but that *Cecidotea* has by modification and heredity been derived from *Asellus*, but because this is most probable it is no reason why, from a systematic point of view, we should disregard its evident generic characters; for it is now generally believed that somehow all the genera of Isopoda have descended from some primitive form or genus. Because, then, we do not know with some degree of certainty that *Cecidotea* has recently diverged from *Asellus*, and can see that the generic characters it possesses have been the result of its underground life, we should yet, from a purely taxonomical point of view, regard it as a good genus. Of the genus *Craugonyx* some species are blind and others are not, but the blind species do not present other important differences. It is so with the species of *Phalan-*

¹Bull. Illinois Mus. Nat. Hist., 1, 1876, p. 11.

²Mem. Nat. Acad. Sci., IV., p. 30.

godes, where the loss of eyes is not always accompanied by other changes in form and structure, and so with other cases.

If we turn to the European *Asellus forelii* Blanc, a blind species from the abysses of Lake Leman, we see that it does not belong to our genus *Cecidotea*, although it has been referred to *Cecidotea* by Fuchs in his paper on the fauna of the deep sea. *Asellus forelii*, compared with specimens of *Asellus aquaticus* from Belgium, is about half as long and broad as *A. aquaticus*; the body has retained about the same proportions; the telson (abdomen) is little, if any, narrower or elongated. Both branches of the caudal stylets are of about the same length as in *A. aquaticus*. *Asellus forelii*, then, appears to us to be evidently a depauperated species, closely allied to *A. aquaticus*, which has lost its eyes by its life in supposed perpetual darkness at or near the bottom of Lake Geneva. Its generic characters are identical with those of its parent form, *A. aquaticus*. So also are those of *A. caraticus* Schiödte, found in wells in Germany, and which closely resembles *A. forelii*, only differing in slight specific characters. It is evident that these two blind species were originally derived from *A. aquaticus*, and hence have retained the generic characters and specific marks of that European species as compared with our American *A. communis*.

When, however, we turn to our *Cecidotea stygia* and *nickajackensis*, we find that they are not only not congeners of the blind European *Aselli*, but that they are also not congeneric with the American *Asellus communis*, and that there are no intermediate forms connecting them, although the eyed species of *Asellus* are somewhat variable. Hence, we feel warranted, on taxonomic grounds, whatever may be our theory about their origin, to retain the genus *Cecidotea*.

Since the above was written, three species of *Asellus* have been described, *Asellus hoppina* Garman, *Asellus tonolowensis* Harford, and *Asellus attenuatus* Richardson; the former from southwestern Missouri, the second from California, and the latter from the Dismal Swamp. There is probably still another species, as yet undescribed, which occurs in the District of Columbia. The Southern States have been very poorly explored for their fresh-water crustacean fauna, and there can be no doubt that when the work is undertaken many additional species of *Asellus* will be brought to light. They, therefore, are more abundant than Packard supposed, and exist, probably, as distinct species in nearly every cave region.

Dr. Packard's claim "that the two or three species of *Cecidotea* are congeneric among themselves on one hand and generically distinct from the genus *Asellus* on the other," is a statement which we could understand had he not followed it up with the statement that "the species have probably arisen independently." A genus, according to the usual conception, is a natural aggregation of species and not a heterogeneous assemblage of species, grouped together simply because they happen to resemble each other. That such heterogeneous genera do exist and are accepted is quite probable, but they are accepted because we know nothing more of the animals than that they look alike. The genus *Cecidotea* presents a case in which, in spite of the lack of good generic character and the very strong probability—one might almost say certainty—that the species are not of similar origin, caremologists have been willing to group them together. In this connection we are strongly reminded of the effort of Cope to establish the genus

Oreonectes to contain the blind crayfishes. These in their way possess the very characters which have been given generic value in *Cecidotea*; they are white, eyeless, and more elongate than the surface dwellers, but there can be no doubt that the five or six known species of blind crayfish have had an altogether independent origin and are less closely related to each other than to species with eyes living outside the caves. The remarks of Hagen¹ regarding the invalidity of the genus *Oreonectes* may very well apply here.

On looking at the general characters of cave-inhabiting animals it will be seen that nearly all have been affected in the same general way: loss of color, more or less complete degeneration of the eyes, and a corresponding hypertrophy of the tactile organs are characteristic.

In some groups (for instance, the *Amphipoda*) there have been found intermediate forms between the surface and true subterranean varieties, but so far this has not been accomplished with the Isopods. Packard mentions a case, however, which is extremely suggestive: a specimen of *A. communis* from a well in southern Indiana was bleached perfectly white, but retained all the other characters of its species. It is a well-known fact that occasionally *C. stygia* has on the top of its head, where its eyes should be, a few facets, showing that the loss of eyes has been so recent that individuals occasionally revert to the primitive characters. However, there is lacking at the present time the positive evidence that this genus is not a natural one, or that we find here a case of the independent development of similar characters. I therefore accept the genus on the grounds of convenience, feeling certain that future investigations will throw light on its origin.

MANCASELLUS MACROURUS Hager.

This species was obtained in some abundance at various localities in the region visited. I found it first in the John Ross spring at Ross-ville, Georgia, where it inhabited the cold water close to the rock crevices from which the spring issued. Beyond 20 or 30 feet downstream it ceased to occur. At Nickajack Cave it was fairly abundant just outside the cave, on the under side of flat rocks and in the crevices of decaying logs of wood. It was most common in a dimly lighted crevice at the mouth of a tunnel-like outlet for the pool at the front of the cave, where in a few minutes I picked some fifty specimens from some submerged

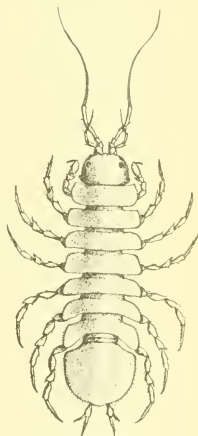


FIG. 1.—MANCASELLUS MACROURUS.

¹Hagen, Amer. Nat., VI, 1872, p. 494. Note also the genus *Stygobromus* Cope, for the subterranean *Gammaridae*, Amer. Nat., VI, July, 1872, p. 422.

driftwood. The congregation at this point may have been due to the presence of the driftwood, but this was also abundant in better lighted locations and did not seem to be inhabited by the crustaceans.

CÆCIDOTEA RICHARDSONÆ Hay.

It was confidently expected that one result of the reexamination of Nickajack Cave would be the collection of the various species of animals described from this locality by Packard,¹ but it was not until the last

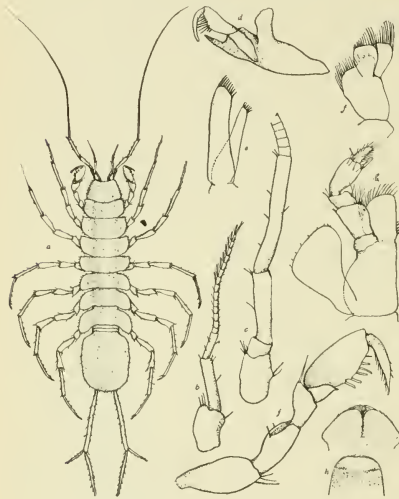


FIG. 2.—*CÆCIDOTEA RICHARDSONÆ* HAY.

- | | |
|---|---------------------|
| a Dorsal view of entire specimen $\times 6$. | f Second maxilla. |
| b First antenna. | g Third maxilliped. |
| c Second antenna. | h Upper lip. |
| d Mandible. | i Lower lip. |
| e First maxilla. | j Gnathopod. |

day of my visit that I was able to find what I supposed to be his *Cæcidotea nickajackensis*. A few specimens were collected; and on a critical examination it quickly became evident that either the description and figures of Dr. Packard's *C. nickajackensis* are altogether at variance with the facts or my species was a distinct one. As Dr. Packard's types have been lost, it can not be satisfactorily determined which is the proper view to take; but for many reasons, some of which are given below, the latter seems to be the only acceptable one.

Description.—A preliminary description of the new species was published soon after my return to

Washington;² but now that figures have been prepared, it seems desirable to describe it in detail.

To a certain degree the general aspect is that of *C. stygius*; the animal is slender, white, eyeless. The slenderness, however, is much more pronounced, and the long, sprawling legs recall strongly certain of the *Ligidae*. The whiteness, and especially the apparent frailty of the body, is much more noticeable than in *C. stygius*.

The body is flattened quite as strongly as any member of the genus, being slightly convex along the median line only. The greatest

¹ Packard, The Fauna of Nickajack Cave, Amer. Nat., XV, 1881, p. 880.

² Proc. Biol. Soc. Wash., XIV, 1901, p. 180 (*Cæcidotea richardsonæ*).

breadth is at the last thoracic segment, and the greatest length, exclusive of appendages, is about four times the greatest width.

The head is considerably broader than long, concave in front, convex on the sides, and with a small, indistinct lobe near the outer posterior angle.

The first body segment fits the head very closely, but the anterior corners are slightly produced and the posterior portion of the lateral border somewhat swollen, so as to leave a rather prominent sinus a little in front of the middle of the border. The second segment is more nearly straight along the anterior margin, has sharp anterior and broadly rounded posterior angles. The third segment is quite similar to the second. The fourth segment is still of the same general character as the preceding, but is more nearly alike anteriorly and posteriorly than any of the other segments of the body. The fifth, sixth, and seventh segments have their lateral expansions directed backward, slightly in the fifth, and more strongly in the seventh.

Behind the seventh segment can be seen two very small annular segments of the abdomen.

The telson is one-fourth longer than broad and about one-fourth longer than the greatest width of the body. All its angles are broadly rounded and its upper surface is only slightly convex.

All the segments of the body and the head and telson are thickly covered with fine, short, bristle-like hairs, which project in every direction. They are most evident about the margins of the body, but may be found everywhere.

The antennule is about as long as the peduncle of the antenna. The basal segment is broad and somewhat enlarged distally. The second segment is long, cylindrical; the third is shorter. The flagellum is composed of about fifteen segments, all of which bear one or two slender setæ at the distal border, and the outer seven or eight bear, in addition, each a single spatulate sense organ.

In the antenna the first two segments are short, the third slightly longer than the first and second combined, and the fourth is as long as the first, second, and third taken together. The flagellum is very long and slender, so that the entire antenna is fully as long as the body. The mandibles have a cutting edge and a broad grinding surface. The palpus is well developed and provided with a strong hand-like extremity.

The maxillæ and maxillipeds do not present characters of importance.

The first pair of ambulatory legs (gnathopoda) are enlarged and subchelate. The hand is broad, inflated, and convex; the dactyl is strong and has an acuminate, somewhat sinuous, tip, and is provided, especially along its opposable margin, with stiff bristles. It shuts against the hand between two rows of strong spike-like teeth. The

carpal segment is produced and spiniform at its outer distal angle. The meros bears on its tip a slender spine almost as long as the segment.

The succeeding pairs of walking legs are slender, hairy, and end in very slender, acute, claw-like dactyls.

The uropods are about one-half as long as the body. The basal segment is slender, subcylindrical, straight or slightly curved, and the terminal segments are slender and gradually tapering from the base to the end. The outer of these terminal segments is not much over half as long as the inner. In a perfect specimen the inner is considerably over half as long as the basal segment.

Length of body and uropods about 20 mm.

Habits.—Although I was able to learn comparatively little about the habits of this animal, the little I got is of interest and will serve to contrast this species with its relatives. They were found clinging to the under side of flat rocks well out in the cave stream, where the current was strong and the depth usually over a foot. Their movements were rapid, and they seemed to have no difficulty in running from one place to another over the rocks, retreating always to the lower side and hiding beneath some convenient angle. As a last resort they would loosen their hold on the rock and float away in the water. When in their native element, their sprawling legs and quick movements were very noticeable. When removed from the water they were absolutely helpless, not even having strength sufficient to raise their legs or straighten out their bodies.

Comparison and distribution.—*Cecidotea nickajackensis* Packard, from the same locality, is described as follows:¹

Body longer, narrower, and slenderer than in *C. stygia*. The antennæ are sometimes very long and reach to the end of the third joint of the second antennæ; they are sometimes nearly twice as long as in *C. stygia*, and are purplish white, while the flagellum is provided with long hairs.

The second antennæ are as long as the head and extend backward as far as the base of the abdomen. The legs are much longer and slenderer than in *C. stygia*. The abdomen is long and narrow, and the caudal appendages are moderately long in one specimen and short in another. In one individual the outer branch is much shorter and smaller than in the others, and in most it is as long as the basal joint. On the whole, the caudal appendages are no longer than the telson or terminal segment of the abdomen, while in *C. stygia* they are half as long as the entire body.

This species forms in the antennæ and slightly purplish color and the proportions of the leg joints perhaps a

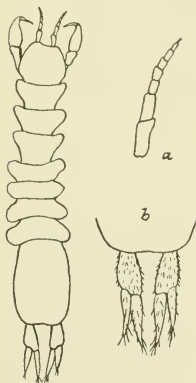


FIG. 1.—*CECIDOTEA NICKAJACKENSIS* PACKARD.

a Antennule;

b Caudal stylets. After Packard.

¹ Packard, The Cave Fauna of North America, Mem. Nat. Acad. Sci., IV, 1887.

nearer approach to the genus *Asellus* than that of Mammoth and Wyandotte caves. On the other hand, *C. stygia* approaches *Asellus* more in its shorter, broader body, with the shorter, broader abdomen. It seems quite evident that the two species must have descended from different species of *Asellus*. Whether there is an additional species in the Southern States from which the present species may have been derived remains to be seen.

From the above description it would seem that the chief difference between *C. nickajackensis* and *C. richardsonæ* lies in the character of the uropods, but a reference to the figures accompanying Dr. Packard's description shows several more important characters in which this species do not correspond with the present one. The first antennæ are short and have a flagellum composed of not more than seven segments; the present species has about fifteen. The outline of the head and body is quite different, though this may be due to faulty drawing. The shape of the telson is very different, being much longer in proportion to the length of the body and its own width than in *C. richardsonæ*.

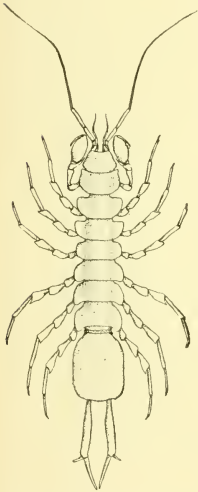


FIG. 4.—*CECIDOTEA STYGIA* PACKARD, MAMMOTH CAVE, KENTUCKY.

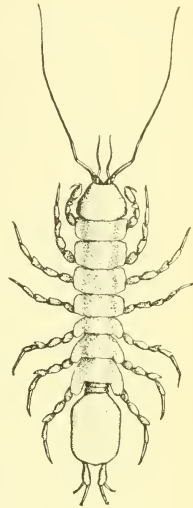


FIG. 5.—*CECIDOTEA NICKAJACKENSIS*, METCALF, GEORGIA.

During my examination of the new species Miss Harriet Richardson kindly furnished me with specimens of an eyeless *Cecidotea* from Metcalf, Georgia, which she has identified as *C. nickajackensis* Packard.

It seemed rather improbable that the species should appear in two localities so far apart as the northern and southern limits of the State of Georgia, but a careful comparison with Packard's description and figures showed that it corresponded very well, although differences are still to be found in important characters.

Regarding them, in the absence of better proof,¹ as *C. nickajackensis* Packard, we find the following differences between *C. richardsonæ* and *C. nickajackensis*:

C. nickajackensis has the first antennæ shorter, composed of about

¹The Metcalf specimens may represent a distinct species, in which case it may be known as *C. troglodytes*. Type, No. 26186, U.S.N.M., Metcalf, Georgia.

ten segments, *C. richardsonæ* has fifteen. The second antennæ are shorter, not equaling the length of the body; in *C. richardsonæ* they are longer than the body. The sides of the body are nearly parallel,

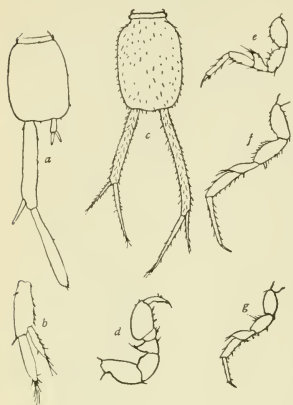


FIG. 5.—THE THREE SPECIES OF CECIDOTEA.

a Telson and uropoda of *C. stygia* (Mammoth Cave).

b Uropod of *C. nickajackensis* (Metcalf, Georgia).

c Telson and uropoda of *C. richardsonæ* (Nickajack Cave).

d Gnathopod of *C. nickajackensis* (Metcalf).

e Fifth pereopod of *C. nickajackensis* (Metcalf).

f Fifth pereopod of *C. richardsonæ* (Nickajack Cave).

g Fifth pereopod of *C. stygia* (Mammoth Cave).

the head nearly, if not quite, as wide as the broadest segment. In *C. richardsonæ* the body is widest in the middle and tapers toward each end; the head is considerably narrower than the first body segment. In *C. nickajackensis* the telson is long, with slightly concave sides, and the uropods are short, their basal segment is enlarged at its distal extremity, and the terminal segments are about as long as the basal portion; there are tufts of bristles at the ends of the terminal segments and a very few rather large bristles along the margins of both basal and terminal segments. In *C. richardsonæ* the telson is convex sided and shorter, the uropods are very long and slender and thickly covered with short bristles, the basal segment is fully as long as the telson, and the terminal segment half as long. There are differences also in the appendages, but the above are sufficient for our purposes.

Compared with the well-known *C. stygia*, the specimens from Metcalf seem to resemble that species rather than *C. richardsonæ*, but the differences are great enough to show that it has descended from some other, but closely related, species of *Asellus*. In order that comparisons may readily be made, I have prepared figures of the three species mentioned and have copied Packard's figures of *C. nickajackensis*.

Family ONISCIDÆ.

Genus PORCELLIO.

PORCELLIO LÆVIS Latreille.

This species was found in great abundance under stones a short distance from the entrance to the cave. They were well known to the natives of the region, and are used by some of them as a medicine to produce an eruption in the case of hives, measles, and similar diseases. The recipe calls for "nine sow bugs crushed in a small quantity of lukewarm water." The dose is taken internally, and is said to be very efficacious.

Order AMPHIPODA.

Family GAMMARIDÆ.

Genera NIPHARGUS and GAMMARUS.

Under the generic name *Niphargus* Schiödte I place the species described as *Crangonyx antennatus*, by Dr. Packard,¹ as I find it agrees much more closely with that genus than with *Crangonyx* or *Gammarus*. As remarked by Chilton,² the genera *Crangonyx* and *Niphargus* are very closely related, differing only in the fact that the telson in the latter genus is divided, while in the former it is entire. In the present species the only parts in which there is a difference from the other species of the genus are the last pair of uropods, which do not have the outer branch excessively elongated.

Although the various species of *Niphargus* are well-known inhabitants of wells, springs, and subterranean water courses in the Old World, no species has heretofore been described from North America. That I do not claim the honor of being the first to recognize the genus in this country is due to the retentive memory and apparently limitless information of my esteemed instructor and friend, Dr. Theodore N. Gill, who has just called my attention to a mention of it in a list of the crustacea of the District of Columbia, published in a rather obscure work as long ago as 1861.³ The name was evidently applied with some doubt, as it is followed by an interrogation mark. Dr. Gill was also able to give some interesting information regarding this citation and the specimen upon which it was based. The list of crustacea, it seems, was furnished by Stimpson, to whom, however, no credit is given in the book. The specimen (for according to Dr. Gill's recollection there was but one), which is called *Niphargus*, was sent in from some well near Washington, and in conversation Stimpson expressed himself as certain that it belonged to that genus. Unfortunately, no further reference was made to the species, and no other specimens have been obtained.

That other species of this genus have been observed in North America I do not doubt, but they seem in all cases to have been described as *Crangonyx*. The two genera are very closely related, and differ apparently only in the telson, which is entire in *Crangonyx* and divided in *Niphargus*. *Crangonyx bifurcus* O. P. Hay is a *Niphargus*; *C. lucifugus* O. P. Hay, *C. Packardi* Smith, *C. tenuis* Smith, and *C. ritireus* Smith seem to be correctly placed; *C. gracilis* Smith has the telson slightly emarginate, but not divided to any appreciable extent in any of the specimens which I have examined. *C. mucronatus* Forbes is

¹ Am. Nat., XV, 1881, p. 880.

² Trans. Linn. Soc. Lond., 2d ser., VI, pp. 218-220.

³ Phelps's Washington Described, 1861, p. 34.

certainly neither *Crangonyx* nor *Niphargus*, but belongs to a distinct genus for which I propose the name *Bactrurus*. *C. flagellatus* Benedict differs from all the others in having the last two segments of the urosome coalescent, and therefore can not be a *Crangonyx*, but should stand as the type of a distinct genus which may be known as *Stygonectes*.

NIPHARGUS ANTENNATUS (Packard).

The specimens from which this description is written were taken at various places within Nickajack Cave, and undoubtedly represent

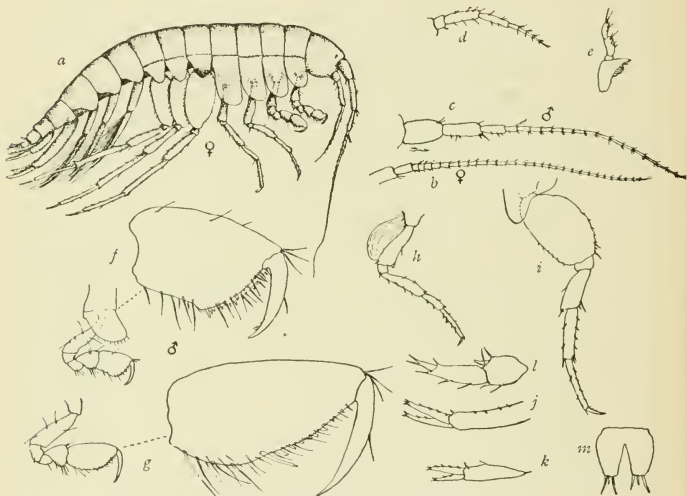


FIG. 6.—NIPHARGUS ANTENNATUS.

- | | | | |
|---|-------------------------------------|---|-----------------|
| a | Right lateral view of adult female. | h | Third pereopod. |
| b | First antenna of female. | i | Fifth pereopod. |
| c | First antenna of male. | j | First pleopod. |
| d | Second antenna. | k | Second pleopod. |
| e | Mandible. | l | Third pleopod. |
| f | First pereopod. | m | Telson. |
| g | Second pereopod. | | |

Packard's *Crangonyx antennatum* described from this locality in 1881.¹ They differ slightly in the specific character and belong to a different genus, but these differences are of such a nature as to make it seem probable that they are the result of the poor material from which Dr. Packard wrote his description.

Body slender, smooth. Head more elongate and less deep than usual in this genus. Eye composed of a few slightly pigmented facets

¹Am. Nat., XV, 1881, p. 880.

or wanting altogether, when present of no definite shape. First antenna more than half as long as the extended body; with a small secondary flagellum of about two articles; the flagellum is more than twice as long as the peduncle and composed of about sixteen segments in the male and twenty-nine in the female. Second antenna short, not half as long as the first antenna, flagellum not much longer than the second or third segments of the peduncle, composed of five or six articles.

First pair of legs of the male with the carpus broad, triangular, and armed with numerous stiff hairs, most of which stand near the inferior angle. Propodus subquadrangular, broadest distally, and possibly a little produced at the inferior distal angle; inferior margin with a number of stout hairs; palmar surface with a deep groove, on each side of which are a number of strong teeth and stiff hairs. Dactyl curved and strong, as long as the palmar surface; in the female these parts differ in being smaller and less strongly armed than in the male.

Second pair of legs of the male with the carpus similar in general form and armature, but proportionally broader and stouter. Propodus considerably larger than that of first pair of legs and elongate, twice as long as broad; the greatest width is at a point about one-fourth of the distance from the posterior end, and from this point the width of the segment narrows rapidly and nearly uniformly to the base of the dactyl; the superior margin is slightly convex; the inferior margin, the shape of which has already been described, is posteriorly provided with a considerable number of long, stout hairs, while the palmar surface, extending over two-thirds of the infero-anterior margin, has a few bristles and ten or more strong teeth in two rows between which the dactyl can be closed; of these teeth the inferior one or two are much larger than the others; the dactyl is larger and stronger but less curved than that of the first pair of legs. In the female the second pair of legs is only slightly larger than the first pair, and the armature of the propodus is weak.

The fifth, sixth, and seventh pairs of legs are strongly developed and bear on their posterior margins especially an unusual number of fine, hair-like spines.

Epimera of the first four thoracic segments rather strongly developed, the fourth being unusually large and quadrangular.

Segments of the abdomen rounded above and without a trace of the spines characteristic of the genus.

Telson divided nearly to its base, each division truncate, and with three or four rather stout spines.

Posterior pair of abdominal appendages with the inner ramus short and rudimentary, the outer well developed and composed of two segments.

No marked variation is observable in the alcoholic specimens, except

that in one example the eyes are entirely gone while in the others the eyes are present, but very small. Dr. Packard has called attention to the well-developed eyes; compared with other subterranean species they may be regarded as well developed, but when compared with the *Gammarus* in the pool just outside the cave their eyes are minute and not more than rudimentary. In the living animal a great variation was observable in the color, some being pure white while others were inclined toward the purplish spoken of by Packard. The original description of *C. antennatus* is here quoted, but it must be understood that the identification of my specimens with Packard's species has been on account of the correspondence of his figure and type locality rather than the description.

It is a large and purplish species; the first antennæ very long; the flagellum with 20 to 24 joints; the entire antennæ being over one-half and nearly two-thirds as long as the body; the last joint of the peduncle being slightly more than half as long as the penultimate joint. Compared with *C. gracilis* Smith, from Lake Superior, it differs in the form of the eyes, the longer and stouter first antennæ, the flagellum

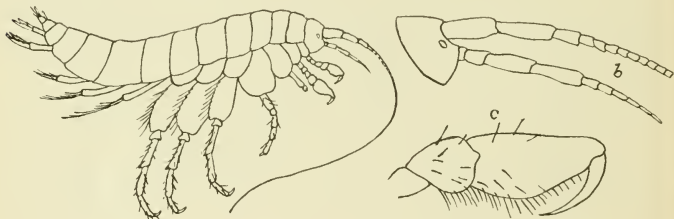


FIG. II.—CRANGONYX ANTENNATUM.

b Head with base of upper and lower antennæ and eyes.

c Manus of second pair of feet. After Packard.

having a greater number of joints, and in the different proportions of the joints of the peduncle. * * * The fourth pair of epimera are usually large and square. The telson, together with the caudal stylets, is much as in *C. gracilis*, but the rami are slightly stouter and more polished and the spinules a little stouter. It is probably a little larger species than *C. gracilis*, the specimens being 6 to 7 mm. in length; the eyes are not so distinct and are only one-fourth as large as in *C. gracilis*.

I first met with this crustacean well within the cave and beyond the point where the last traces of daylight were visible. They were found on a piece of decaying wood, but, although a number were seen, they were so active that only a few were obtained for preservation. I afterwards found them in various parts of the cave stream, always on decaying wood.

Although there are several rather important differences between my specimens and the description of *C. antennatum*, I have no hesitation in regarding it as Packard's species, as it agrees very well with the figures, but I find it must belong to the genus *Niphargus* of Schiödte rather than to *Crangonyx*.

GAMMARUS PURPURASCENS, new species.

Type.—No. 25544, U.S.N.M. Collected September 6, 1901, by W. P. Hay, at the mouth of Nickajack Cave, Shellmound, Tennessee.

Eyes large, reniform, with the concavity anterior. Head large, deep, notched in front for both antennæ, and with a very short rostrum. First antennæ about half as long as the body, with a small secondary flagellum of three articles; flagellum with from twenty to thirty articles; all the basal segments and those of the flagellum plentifully provided with hairs. Second antennæ a little over half as long as the first pair; first basal segment short and broad, second and third short, the second with a spine on the inferior margin; fourth and fifth segments of nearly equal length, each longer than the first three seg-

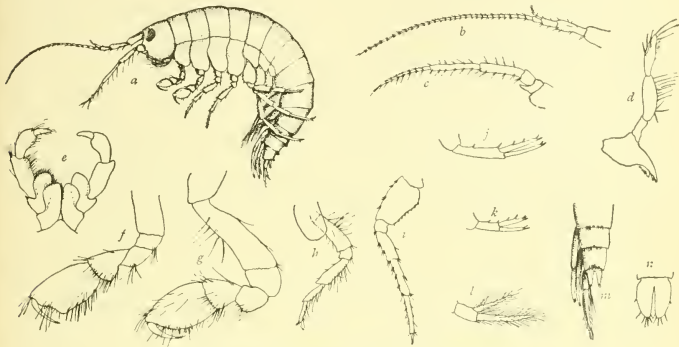


FIG. 7.—GAMMARUS PURPURASCENS, NEW SPECIES.

- a, Left lateral view of adult male. g, Legs of first pair. l, Appendage of thirteenth segment.
 b, First antenna. h, Legs of third pair. m, Dorsal view of abdomen and appendages.
 c, Second antenna. i, Legs of seventh pair. n, Telson.
 d, Mandible. j, Appendage of eleventh segment.
 e, Third maxillipeds. k, Appendage of twelfth segment.
 f, Legs of second pair.

ments together; flagellum, composing about one-third of the appendage, of nine articles. All these segments, like those of the first antennæ, are plentifully provided with stiff hairs, and the segments of the flagellum bear, in addition, each a particular mushroom-shaped sense organ.

First pair of legs of the male strong, but of slightly smaller size than those of the second pair. The carpus is short and broadly triangular; its distal margin, especially near the inferior angle, is abundantly supplied with long bristles. The hand slightly broader than the carpus, its superior and inferior margins convex, the palmar surface very oblique and armed on each side with scattered spines and teeth between which the dactyl closes; the bristles on the hand are most

abundant near the palmar surface and the distal end of the superior margin. The dactyl is about one-half as long as the hand, strongly curved and very acute.

The second pair of legs differs from the first not only in size but in the shape of all the segments and their armature of hairs and bristles. The carpus is more perfectly triangular in profile, but has an almost exactly similar arrangement of bristles. The hand is somewhat quadrangular; its superior and inferior margins are subparallel and the palmar surface is only slightly oblique; there are a few teeth and hairs at the sides of the palmar surface, another small bunch of slender hairs near the articulation of the dactyl, and a rather extensive patch of stiff hairs on the inferior margin. The dactyl is straighter than in the preceding appendage and more blunt.

The other pereopods are similar to those of the *Gammaridae* except that the third and fourth are very hairy and the fifth, sixth, and seventh have the basal segments much narrower, broadest at the proximal end and gradually narrowing distally.

Segments of the abdomen rounded above, the fourth, fifth, and sixth with the posterior margin slightly produced in three places—one in the middle and one very near the middle line on each side—and armed with three small clusters of spines. The spines of the middle clusters are rather smaller than those of the side clusters.

Both rami of the posterior caudal stylets with many slender hairs but no teeth.

Telson divided almost to the base; each division with a spine near the middle of the outer margin and a series of about five at the distal extremity.

This species resembles *Gammarus limnæus* Smith, but has much longer antennæ, larger eyes, differently arranged spines, and a different telson. Judging from Smith's figure¹ the posterior caudal stylets are much longer in *G. limnæus*. The second antennæ of *G. purpurascens* have fewer segments than *G. limnæus*, but the difference is more than made up by the very numerous segments of the first antennæ.

The variation in the number of segments in the first antennæ is apparently dependent upon sex and age; they are longest in fully adult males, slightly shorter in adult females, and shortest in the young, without distinction as to sex.

I found this species quite common among the growing vegetation and decaying wood in a pool at the mouth of the cave. In color they were a dark purplish gray and their movements in the water were very quick, so that their capture was quite difficult. I also found them in the spring at Rossville, Georgia, but of smaller size and in fewer numbers.

¹ Rept. U. S. Comm. Fish and Fisheries, 1872-73, p. 651, pl. II, fig. 6.

Order MACROURA.

Family ASTACIDÆ.

Genus CAMBARUS.

CAMBARUS BARTONI CAVATUS, new subspecies.

Type.—U.S.N.M. 25017. Powell R. Tazewell, Tennessee.

Distribution.—Eastern and central Tennessee.

Similar to *C. bartoni*, but with broad, parallel sided, deeply excavated rostrum; the appearance of deep excavation being partially given by the unusually high elevation of the margins of the rostrum. The areola is narrower and more thickly punctate than in *C. bartoni bartoni* and the epistoma is triangular. The antennæ extend almost to the end of the abdomen and the carapace is more nearly cylindrical.

While, as in all the other subspecies of *C. bartoni*, there is quite a little variation noticeable in this form, the characters given above will be found to hold good in the majority of cases. Intermediates with the Kentucky or Virginia forms must of course be expected.

There are in the United States National Museum specimens of this subspecies from the following localities in Tennessee: Tennessee River near Knoxville and Chattanooga; Balls Creek near Tazewell; Indian Creek near Cumberland Gap, and Powell River at Tazewell. The latter, which have been selected as the types, have the characters of difference most marked.

I found this crayfish in small numbers in the cold water flowing from the John Ross Spring at Rossville, Georgia. One large female carried young.

CAMBARUS HAMULATUS Packard.

The crustacean of the greatest interest to me in Nickajack Cave was the blind crayfish, *Cambarus hamulatus*, described by Packard.¹ The first specimens were observed during my first visit to the cave; a male and a female about 45 mm. in length were found on a mud bank at the edge of the water. No more could be collected during the first week, although repeated search was made in all possible localities.

At the time of my second visit to the cave, after the water had fallen and was clear again, a specimen was occasionally observed. But it was not until I began to look for them under the rocks in the cave stream that I found how common they were. They appeared habitually to live under such, where they had scooped out a cavity in which to lie and from which they seemed seldom to travel. When disturbed, if they sought to escape, it was by crawling away rather than by swimming, and they would seldom move more than a few feet. Most often, however, they would lie perfectly still, and after the cloud of mud

¹ *Orconectes hamulatus* Packard, Amer. Nat., XV, 1881, p. 880.

caused by raising the stone had cleared away, they could be seen lying quietly in their cavity or treading the mud to avoid being covered up. They were easily caught in the hands, as even after they had been touched they made no great effort to get out of danger. Indeed, in one case, I let a large specimen drop back into the water and a minute or so later found it lying at my feet; it had sunk like a stone and had not tried even to crawl away. They seemed to be totally devoid of the senses of sight and hearing, and the sense of touch did not seem to be nearly as well developed as in *C. pellucidus*. I tried many experiments to determine these points, as well as those regarding the habits mentioned above. As is well known, *C. hamulatus* differs considerably from *C. pellucidus* and is more closely related to such forms as *C. bartoni* or *C. latimanus*, which are surface dwellers and provided with well-developed eyes. Nevertheless, the general appearance is so strikingly like *C. pellucidus* that without a careful examination it would be exceedingly difficult to distinguish the two species. Compared with the two other blind crayfishes from this country, *C. setosus* and *C. acherontis*, the resemblance is less marked and the greatest difference is noticed between *C. hamulatus* and *C. setosus*. Yet *C. setosus* is the closest relative of *C. hamulatus*, while *C. pellucidus* and *C. acherontis*, which are very dissimilar in general appearance, are closely related. These facts are cited to show that there are apparently certain characters in the crustacea which readily lend themselves to modification under subterranean influences, but which mean very little when it comes to detecting family, generic, or specific relationships or differences. Sense organs and color may change with such rapidity that the animal becomes a true spelean species before it is able to so change its habits as to become perfectly adapted to a subterranean life. Thus, I would regard the habit of living under stones of *C. hamulatus* and *Cecidotea richardsonæ* as a primitive instinct to which the animals cling in spite of the fact that it is useless. *C. pellucidus* is probably an older species and has adapted itself more perfectly to conditions in the caverns where no special concealment is necessary.

As to the ancestry of *C. hamulatus* we would most willingly look to some species of the *C. bartoni* group, which occurs in this region, and of the three which are known to occur, *C. bartoni*, *C. latimanus*, and *C. extraneus*, the latter is far more like *C. hamulatus* than either of the other two. There is, however, another species, *C. jordani* Faxon, which in some characters agrees still more closely with *C. hamulatus*, and its range is not so far away as to make it impossible that it will still be found in the same territory. The wide and long areola, the lateral and branchiostegial spines of the carapace, the flat rostrum with lateral spines and long acumen, triangular epistoma, long antennæ (even longer in *jordani* than in *hamulatus*), the shape of the antennal scale, the development of hair on the inner faces only of the third maxilli-

pedes, and the long fingers are all characters in which the two resemble each other. They differ markedly in the shape of the carapace, areola, and hand, and the body and all the appendages in *C. hamulatus* are more elongate and slender. The characters of difference, however, are undoubtedly due to the subterranean influences and are to be explained as Dr. Lönnberg has explained the differences between *C. archerontis* and *C. clarki*.

Unfortunately we know only the second form male of *C. jordani* and any comparison of the rather peculiar annulus ventralis of the female of *C. hamulatus* with that of the other species is impossible.

Of this species a series of twenty-six was obtained from Nickajack Cave and one specimen from a small cave known as Wine House Cave, about three-fourths of a mile distant from Nickajack.

Altogether there are fifteen females and eleven males, and of the latter ten are in the second form and one first form.

In size the specimens range from 17 to 65 mm. in length, both the extremes being found in the females. Of the males the smallest is 33 and the largest 55 mm. long.

Very little variation is observable in this series, and such as there is is confined to minute characters; thus, in some specimens the cervical groove is arcuate, in others slightly sinuate; in some the acumen of the rostrum is very slender, in others stouter. In the larger specimens there are two or three smaller spines, which are less developed or wanting altogether in the smaller specimens.

The first form male, which has hitherto not been observed, differs from the second form in having slightly stouter chelae, the hooks on the third pair of legs are much stronger (in some of the second form males they are wanting), the basal segment of the fourth pair of legs is perhaps provided with a little larger knob, the first pair of abdominal appendages have the tips of the branches sharply recurved, the tips of the inner branch is slender, straight, and spiniform, and is directed backward at right angles to the rest of the appendage and a little outward; the outer branch is curved over the tip of the inner, it is thin and blade like and horny.

CAMBARUS LATIMANUS STRIATUS, new subspecies.

Type.—U.S.N.M. 25019. Nashville, Tenn. E. B. Williamson, collector.

Dr. Faxon¹ was the first to call attention to certain aberrant specimens of *C. latimanus* from Blount Spring, Cullman, and Bridgeport,



FIG. 8.—CAMBARUS
HAMULATUS GONOPOD
OF FIRST FORM MALE.

¹Revision of the Astacidae, p. 69.

Alabama, and Ashland, Cheatham County, Tennessee, in which the areola is reduced almost to a line in the middle, the metacarapace is longer in proportion to the procarapace, the fingers are shorter, the tuberculation of the hand weaker, the epistoma narrower and less strongly truncate.

Recent additions to the collection of the United States National Museum and the Museum of Comparative Zoology, of material collected near Nashville, Tennessee, by Mr. E. B. Williamson and a series of specimens collected by myself at Nickajack Cave show that we are dealing with a distinct geographical race of *C. latimanus*, the range of which extends over the eastern portion of Tennessee and northern portion of Georgia and Alabama.

It may be described as follows: Similar to *C. latimanus*, but with the rostrum a little more decurved and perhaps a little broader toward the tip. Suborbital angle rounded, branchiostegian spine developed, but very small, lateral spine of carapace usually represented by a denticle just behind the cervical groove. Areola linear, sometimes almost obliterated, its length equal to the distance from the cervical groove to the base of the rostrum. Epistoma triangular, not truncate, sides convex. Hands with one rather strong row of squamose tubercles along the inner margin and just above it another obscure row of much weaker tubercles, hand and, especially the fingers, deeply and roughly punctate, but not tuberculate, except as just mentioned. The carpus commonly bears strong median and small proximal internal spines and a rather blunt spine below at the distal border, but both this segment and the meros vary, as they do in the typical forms.

The specimens from Ashland City, mentioned above, belong to this subspecies, and the others are, in various ways, intermediate between the typical *C. latimanus* and those just described.

From a series sent alive to the United States National Museum the following color notes were taken, which are interesting in that they show that the same species may have at least two styles of coloration. The sexes were not distinctively colored and there was some variation in each style.

In one, the ground color, in fact nearly the entire body was a clear sage green shading into dirty gray brown on the sides and tail fin and into very dark-brown black on the sides of the head. There were a few blackish shadings on the angles and inner surfaces of the meros, carpus, and chelipeds. The margins of the rostrum, postorbital ridges and the tips of all the spines on the chelipeds and the tips of the fingers were ochre yellow. Beneath, the color was of a uniform light gray.

In the other style of coloration the ground color was a dark brown (near clove brown but not so red), becoming a little lighter on the head

and fading into grayish on the sides. Beginning at the cervical groove and extending the full length of the abdomen, but not including the telson was a conspicuous light-brown stripe, widest on the carapace and with irregular and poorly defined margins, but on the abdomen pretty well defined. In addition to the median stripe, the abdomen had on each side a lateral stripe, well defined along its inner margin, but of uncertain limits outside. There was a faint suspicion of rusty yellow on the sutures in the external blade of the tail fin and the spines of the body were white. Beneath, the color was very light vinaceous.

In the summer of 1901 I found this crayfish in some numbers under the stones in a small pool formed by the stream issuing from Nickajack Cave. The males were all of the second form and both sexes exhibited the two-color phases mentioned above. Several of the specimens were brought alive to Washington, but most of them soon died. Two, a male and female, survived several months, living in a small bowl in which the water was frequently changed and food supplied from time to time in the shape of bits of apple and shreds of meat. November 15 the female shed her shell, but did not exhibit a perceptible increase in size. December 20 the male shed his shell and came out as form I, but without a marked increase in size.

It may be added that among the specimens collected at the mouth of Nickajack Cave, two of the second-form males had evidently shed their shells very recently; so, from evidence now at hand, it looks as if the second-form condition begins in August and lasts until December, but I am inclined to believe that the specimen kept in captivity had its ecdysis somewhat hastened by the unnatural conditions.

CAMBARUS SPINOSUS Bundy.

Specimens of this species (Males f. II and females) were obtained from a small stream flowing from a pond which, in turn, was fed by the cave stream known as John Ross Spring near the town of Rossville, Georgia. They agree very well with typical specimens, except as regards the length of the posterior portion of the carapace, which is a little more than one-half as long as the distance from the cervical groove to the lateral spines of the carapace.

In habits they seemed to be very similar to *C. propinquus* Hagen, living in shallow burrows in the soft mud, in shallow water, or in excavations under flat stones.



A REVIEW OF THE BLENNOID FISHES OF JAPAN.

By DAVID STARR JORDAN and JOHN OTTERBEIN SNYDER,
Of the Leland Stanford Junior University.

In the present paper is given a descriptive catalogue of the blenny-like fishes (*Blenniidae* and *Anarhichadidae*) known to inhabit the waters of Japan. It is based on the collections made by the writers in the summer of 1900 for the museum of Stanford University and on the specimens in the United States National Museum. The accompanying drawings are the work of Mrs. Chloe Leslie Starks and Capt. Charles Bradley Hudson.

Family I. BLENNIIDÆ.

BLENNIES.

Body oblong or elongate, naked or covered with moderate or small scales, which are ctenoid or cycloid; lateral line variously developed, often wanting, often duplicated; mouth large or small, the teeth various; gill membranes free from isthmus or more or less attached to it; pseudobranchiæ present; ventrals jugular or subthoracic, of one spine and 1 to 3 soft rays, often wanting; dorsal fin of spines anteriorly, with or without soft rays; anal fin long, similar to soft dorsal; caudal well developed. Vertebrae in moderate or large number, 30 to 80; hypercoracoid (or "scapula") perforate; shoulder girdle normally formed; suborbital without bony stay.

Fishes of moderate or small size, mostly living near the shore in the tropical and temperate or arctic seas; most of them carnivorous, the Clininae, so far as known, ovoviviparous, the rest mostly oviparous. Dr. Gill divides the group into six families, but the relations of these are very close, and the distinctive characters of some of the families are subject to exceptions.

I. Tropical blennies with the vertebrae mostly in moderate number, usually fewer than 45; lateral line usually arched high above the pectoral; dorsal fin with one or more soft rays posteriorly; anal spines little developed; ventrals well developed, usually 1, 3; gill membranes broadly united, free from the isthmus.

a. Clininae: Body scaly; lateral line high anteriorly; species ovoviviparous as far as known.

- b. Dorsal divided into three fins; scales ctenoid; rather large.....*Tripterygion*, 1.
- bb. Dorsal fin continuous; scales small; shoulder girdle without hook; maxillary normal; mouth large.....*Zacalles*, 2.
- aa. Body scaleless; species viviparous; teeth *comb-shaped*, in a single row; vomer and palatines toothless, or nearly so; lateral line usually arched in front; soft dorsal about equal to spinous.
- c. *Blenniinae*: Teeth all fixed, attached to the bones of the jaws; carnivorous.
- d. Gill-opening relatively large; caudal rounded; gill membranes broadly united, nearly or quite free from the isthmus; one or both jaws with posterior canines.....*Blennius*, 3.
- dd. Gill-opening reduced to a small slit; one or both jaws with posterior canines; caudal rounded or angular.
- e. Dorsal elevated in front.....*Petroscirtes*, 4.
- ee. Dorsal not elevated in front.....*Aspidontus*, 5.
- cc. *Salarinae*: Teeth all movable, implanted on the skin of the lips; herbivorous.
- f. Posterior canine wanting.
- g. Dorsal continuous.....*Salaria*, 6.
- gg. Dorsal deeply divided.....*Scartichthys*, 7.
- II. Blennies, arctic or subarctic; the vertebrae in large number, 50 or more; lateral line various; scales small, cycloid, rarely wanting.
- h. Gill-membranes not continued forward below, the membranes broadly united, sometimes joined to the isthmus; ventral fins small or obsolete.
- i. Pectoral fins relatively short or wanting, never pointed, and not more than half as long as head; pyloric coeca few or none.
- j. Body not covered with crosswise tubes running at right angles to the lateral line.
- k. Dorsal fin composed of spines only.
- l. *Chirolophinae*: Ventral fins well developed, I, 3; gill membranes free from isthmus.
- m. Lateral line obsolete, represented anteriorly by a row of pores; top of head covered with matted cirri; teeth in two rows so aligned as to form a cutting edge.
- n. Head scaly.....*Azuma*, 8.
- m. Head naked.....*Bryostemma*, 9.
- ll. Ventral fins rudimentary or wanting, not more than one soft ray present; dorsal spines short and rigid.
- o. *Pholidinae*: Lateral line obsolete; carnivorous.
- p. Ventral fins reduced to a single spine, with a rudimentary ray; anal spines small.
- q. Head scaly.....*Enedrias*, 10.
- qq. Head naked.
- r. Caudal fin well developed.....*Pholis*, 11.
- rr. Caudal fin very slender, coalescent with dorsal and anal.....*Gunnellops*, 12.
- pp. Ventral fins wanting; no anal spine; top of head with fleshy crests; body partly naked; gill-membranes forming a fold across the isthmus.....*Alectrias*, 13.
- kk. Dorsal fin with its posterior part composed of numerous soft rays; no lateral line; no ventral fins.
- s. *Eulophinae*: Scales wanting; body greatly elongate, the dorsal fin with about 120 spines and about 12 soft rays.

- ss. *Neozoarcinae*: Scales present; body not greatly elongate, the dorsal of 28 to 42 spines and 50 or more soft rays.
- t. Dorsal fin with about 40 spines and about 50 soft rays; a short tentacle above the snout *Neozoarces*, 15.
- tt. Dorsal fin with about 30 spines and about 75 soft rays; no tentacle above snout.
Zoarchias, 16.
- jj. *Dictyosominae*: Body covered with cross-wise tubes at right angles with the lateral line, these forming an elaborate network over the body; dorsal of spines only; gill-membranes broadly united, free from the isthmus. Ventrals obsolete, forming a scale-like appendage in the young, which disappears with age *Dictyosoma*, 17.
- ii. *Opisthocentrinae*: Pectoral fins long and rather pointed, about as long as head; dorsal high; gill-membranes broadly united, free from the isthmus; no lateral line; no ventral fins; species herbivorous.
 - u. Dorsal with its posterior spines short, rigid, and sharp, the anterior flexible.
 - v. Head with small scales; dorsal with hindmost spines only stiff.
Opisthocentrus, 18.
 - vv. Head naked; dorsal with spines becoming strong near the middle, and hindmost ones heavy *Abryois*, 19.
 - uu. Dorsal spines all flexible; head naked.
Pholidopus, 20.
- hh. *Stichæinae*: Gill-membranes continued forward below, the membranes nearly separate and free from the isthmus; dorsal of slender pungent species only; species herbivorous.
 - w. Lateral line present, single, double or triple; body moderately elongate.
 - x. Lateral lines three or more on each side.
 - y. Lateral lines all three complete, each with lateral branches.
 - z. Lateral lines each with numerous short branches, each ending in a pore.
Eruogrammus, 21.
 - zz. Lateral lines each sending out branches at right angles which connect with the other lateral lines, thus covering the whole body with a network of lines *Ozorthes*, 22.

- yy.* Lateral lines without branches
 all three being incomplete.
Stichopsis, 23.
xx. Lateral line single on each side.
Stichacis, 24.
ú. Head moderate, not especially depressed, the eyes large.....*Stichacis*, 24.
uá. Head large, depressed, and pike-like, the eyes small.....*Dinogunnellus*, 25.
uu. Lateral line obsolete; body cel-
 shaped.
U. Pectoral fin with its upper and middle rays shortened; teeth both on vomer
 and palatines*Leptoclinus*, 26.
uu. Pectoral fin with the middle rays longest; palatine teeth small or wanting.
Lumpenus, 27.

1. TRIPTERYGION RISSO.

Tripterygion RISSO, Europe Méridionale, III, 1826, p. 241 (*nasus*=*tripteronotus*).

Emneapterygius RÜPPELL, Neue Wirbelthiere, 1837, p. 2 (*pusillus*).

Emneanectes JORDAN and EVERMANN, Proc. Cal. Ac. Sci., 1895, p. 501 (*carminalis*).

Gillias EVERMANN and MARSH, Rept. U. S. Fish Comm., 1899, p. 357 (*jordanii*).

Body rather robust, covered with moderate ctenoid scales; lateral line complete or incomplete; mouth moderate, the jaws equal; no tentacle on nape; no hook on shoulder girdle; eye large; dorsal fin divided into 3 fins, the first of 3 or 4 slender spines, the second of 10 to 24, the soft dorsal of 7 to 15 rays; caudal rounded; anal fin long; pectoral long, the lower rays simple and thickened. Small fish of the rock-pools of the Tropics, found in most seas.

This group has been divided into four subgenera on minor characters. These may be thus defined:

- a.* Orbit without filament above.
b. Lateral line said to be complete; dorsal rays III-XVII-12; scales rather small,
 40.....*Tripterygion*.
bb. Lateral lines well developed anteriorly, becoming obsolete posteriorly; dorsal
 rays III-X to XV-7 to 10; scales large, about 35.....*Emneapterygius*.
bbb. Lateral line almost obsolete; dorsal rays III-X-7; scales large, rough, about
 35.....*Emneanectes*.
aa. Orbit with a fleshy filament above.
c. Lateral line interrupted, weakly developed behind; dorsal rays III-XII to
 XVII-7 to 12; scales large, 33 to 40.....*Gillias*.
cc. Lateral line said to be complete; dorsal rays V or VI-XVIII to XX-12 to 14;
 scales small, 40 to 50.....(*nigripinne*.)

The two Japanese species belong to the division called *Gillias*.

- a.* GILLIAS: Orbital tentacle present; lateral line incomplete.
b. Dorsal III-XIV-10; A. 21; body with dark vertical bands.....*etheostoma*, 1.
bb. Dorsal III-XVII-12; A. 27; body plain, the caudal mostly black...*bapturum*, 2.

1. TRIPTERYGION ETHEOSTOMA Jordan and Snyder, new species.

Head 4 in length; depth $4\frac{1}{2}$; depth of caudal peduncle $2\frac{5}{8}$ in head; eye $3\frac{1}{2}$; interorbital space 8; snout 3; D. III-XIV-10; A. I, 20; P. 16; scales in lateral series 37.

Body short, subcylindrical anteriorly, deepest above vent; caudal

peduncle narrow, compressed; profile of head steep; eye large, directed obliquely upward; interorbital space narrow, convex, the orbital rim projecting; jaws equal maxillary, except posterior part, concealed, reaching a vertical a little behind anterior edge of pupil; cleft of mouth somewhat oblique; teeth minute, in bands on jaw and vomer; gill-membranes forming a broad fold across the isthmus; anterior edge of shoulder-girdle sharp, without protuberances of any kind; gill-rakers on first arch 6, very short; slit behind last gill small; anterior nostril with a small, flat tentacle; a similar tentacle on upper posterior part of eye; no other cirri or tentacles on head.

Head naked; scales of body ctenoid, those of belly cycloid, a small area at base of ventrals and anteriorly to pectorals naked. Number of scales in an oblique series between lateral line and insertion of second dorsal, counting upward and forward, 4; between insertion of anal and lateral line, 10; lateral line interrupted, anterior part ending a little in advance of base of soft dorsal, the posterior part beginning 2

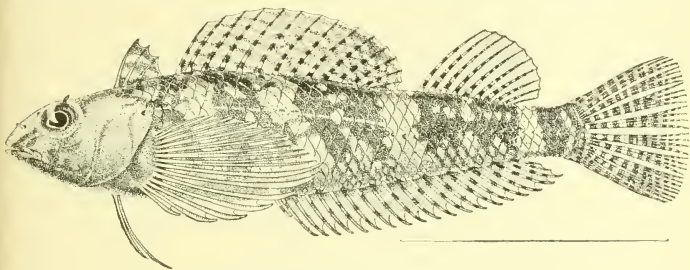


FIG. 1.—TRIPTERYGION ETHEOSTOMA.

or 3 scales forward on the next lower row, extending to base of caudal, the posterior part without pores, each scale with a deep and narrow scallop.

Spinous dorsal in 2 parts, the anterior of 3 slender spines, the second and third successively shorter than the first, which is contained $2\frac{5}{8}$ times in head; in some specimens the membrane uniting the last spine with the back reaches the insertion of the second dorsal; spines of second dorsal slender, highest near the middle of fin; $1\frac{2}{3}$ in head, rays of soft dorsal not branched, the first longest, $1\frac{1}{2}$ in head; membranes of dorsals not incised, that of the first with shallow scallops between the spines. First ray of anal about half as long as the second, the following rays blunt, the tips about as large as the bases, the length $2\frac{1}{2}$ in head; membranes of fin deeply incised between the rays; caudal convex posteriorly, $1\frac{1}{2}$ in head; pectorals large, pointed, the middle rays longest extending to base of sixth anal ray, the lower 7 rays simple, considerably enlarged distally, the membrane incised between them, leaving the tips free; most of the upper rays branched,

the membrane entire; ventral spine minute, the rays united by membrane for about half their length, outer ray shorter than the inner.

Color of female; body yellowish white, crossed by 6 nearly vertical dark brown bands, very irregular in outline, not extending on ventral surfaces, the first passing downward from between the first and second spinous dorsals, behind base of pectoral, the second below anterior part of second dorsal, the third below the posterior part, the fourth and fifth below the soft dorsal, the sixth near base of caudal; the first to fourth bands more or less divided by light blotches within their boundaries; nape with a small poorly defined cross-band; head irregularly blotched with brownish; first dorsal with elongate dusky clouds; second dorsal with slightly oblique dusky bands anteriorly, which branch and intercept, becoming reticulations posteriorly; spines and rays of soft dorsal, anal, and caudal with alternating dusky spots and clear spaces, appearing like oblique bands on the dorsal and anal and vertical bands on the caudal; pectoral faintly clouded with dusky. In the males the ground color is much darker except a narrow white space behind the second and another behind the third dorsal fin, forming vertical bands in bold contrast with the rest of the body. The dark bands described in the female can easily be traced, though they are not so prominent. The fins, except caudal, are nearly black, the second dorsal narrowly edged with white, the soft dorsal and anal with a large white spot on posterior ends. The caudal is colored as in the female. The fins of the male are higher than those of the female, the first dorsal spine about 2 in head, membrane with a broad, deep scallop between second and third dorsal spines.

Described from specimens about 65 mm. long from Misaki. Type No. 7065, Zoological Museum, Stanford University. Cotype No. 50299, U.S.N.M.

Table showing fin-ray and scale counts of seven specimens from Misaki.

Dorsal.	Anal.	Pectoral.	Scales.
III, XV, 10	1, 20	15	35
III, XIV, 11	1, 19	16	37
III, XV, 10	1, 20	15	36
III, XV, 10	1, 21	15	36
III, XIV, 10	1, 20	15	34
III, XIV, 9	1, 20	15	35
III, XV, 9	1, 19	16	36

We have many specimens from Misaki, 2 from Wakanoura, and one from Atami, province of Izu. These beautiful little fishes are found in the rock pools at the ends of the promontories. They cling close to the rocks with their paired fins, even to vertical walls of cliffs.

(*etheostoma*, the darter, a genus of *Percidae*, of similar appearance and habit.)

2. TRIPTERGION BAPTURUM Jordan and Snyder, new species

Head $4\frac{1}{5}$ in length; depth 6; depth of caudal peduncle $3\frac{1}{4}$ in head; eye $3\frac{1}{4}$; interorbital space 10; snout $3\frac{1}{4}$; D. III-XVII-12; A. I, 26; P. 17; scales in lateral series 43.

Body elongate, more slender than in *T. theostoma*; caudal peduncle rather narrow; snout short, anterior profile steep; interorbital space very narrow, concave; eye large, high up, directed obliquely upward, mouth rather large, posterior half of maxillary exposed, extending to a vertical through anterior part of pupil; teeth in narrow bands on jaws and vomer, the outer teeth of jaws slightly enlarged; gill-opening forming a broad fold across the isthmus; shoulder-girdle without protuberances; nasal and orbital tentacles present; two rows of mucous pores below and behind eye; similar pores on chin, preopercle, and occiput; head naked; body with thin, finely ctenoid scales, loosely attached; belly and breast and space anterior to pectoral naked; number of scales in an oblique series between lateral line and insertion of

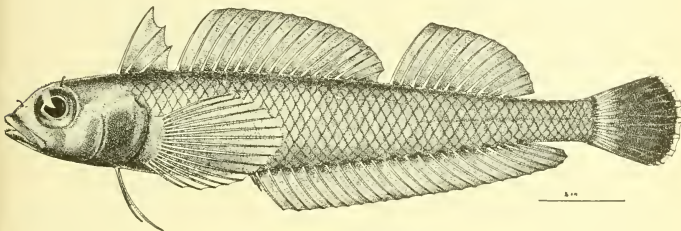


FIG 2.—TRIPTERGION BAPTURUM.

second dorsal, counting upward and forward 5; between insertion of anal and lateral line 9 or 10; lateral line incomplete, on about 28 scales ending below anterior part of soft dorsal, not continued on caudal peduncle.

Spinous dorsal in 2 parts, the anterior of 3 slender spines, the first contained $1\frac{2}{3}$ times in head; middle spines of second dorsal highest, 2 in head; longest ray $1\frac{1}{2}$; anal rays not thickened toward the tips, the longest $2\frac{1}{3}$ in head; caudal rounded, $1\frac{2}{3}$ in head; pectoral pointed, the lower 8 rays simple, no larger toward tips than at bases, upper rays branched, membrane incised between lower rays, entire between upper ones; outer ventral ray about $\frac{1}{3}$ of its length shorter than the inner one.

Color in alcohol, body without bands, pale yellowish, each scale with a dusky border; opercle with a large, pale-brown blotch; snout and lips dusky; first dorsal blackish, the second dusky along the basal part, the third with a few dark specks; anal plain, a row of very

indistinct, small dusky spots on body along its base; caudal black, the base and tip white; pectoral slightly dusky on its upper edge.

The species is known from a single specimen 50 mm. long from Misaki. It is recorded as type, No. 7066 Zoological Museum, Stanford University. It is easily distinguished from *T. etheostoma* by the absence of dark bands on the body, by the thick caudal with white base and tip, as well as by the fin rays.

(βαπτός, dyed; ούρά, tail.)

2. ZACALLES Jordan and Snyder.

Zacalles JORDAN and SNYDER, new genus of Blenniidae (*bryope*).

Body rather elongate; head short, naked, with tufted filaments above the eye; mouth large, with rather stout, bluntish teeth in the jaws; teeth on vomer and palatines; dorsal fin long, with numerous slender spines and many soft rays, the spines subequal; pectorals moderate; scales small, thin and smooth; lateral line developed anteriorly only; shoulder-girdle without upturned hook-like process.

Handsome little fishes of the tide-pools of Japan, allied to the American genera *Lepidoma* and *Labrisomus* (*Gobioclinus*).

(ζακαλλής, very pretty.)

3. ZACALLES BRYOPE Jordan and Snyder, new species.

Head $4\frac{1}{5}$ in length; depth $6\frac{1}{5}$; depth of caudal peduncle $3\frac{1}{2}$ in head; eye 5; interorbital space $11\frac{1}{2}$; snout $4\frac{1}{2}$; D. XXV-17; A. I., 31; P. 14.

Body rather short, compressed; caudal peduncle deep, greatly compressed; eyes far forward, directed somewhat obliquely; interorbital space narrow, with a concave furrow; snout short; jaws equal; maxillary very long, $1\frac{2}{5}$ in head, extending far beyond eye, the posterior half exposed; interior borders of lips fringed; teeth short, blunt, in a single row laterally, in bands on anterior part of jaws, the outer ones slightly enlarged; small teeth on vomer and palatines; gill-membrane forming a broad fold across the isthmus; anterior edge of shoulder-girdle with a sharp ridge; no protuberances; pseudobranchiae large; gill-rakers on first arch 7+9, long, very slender, widely spaced; nostrils tubular, the anterior one with a bifid tentacle; upper part of eye with 3 broad, branched tentacles, the anterior one highest; head naked; body with very thin, cycloid, partly embedded scales, about 21 in transverse series; a naked area above lateral line and on breast and belly; lateral line incomplete, with about 21 pores, ending above tip of pectoral; dorsal fin continuous, extending from nape to caudal peduncle; spines slender, soft at tips, highest in the region of the seventh, the length contained about 2 times in head; soft dorsal higher than the part of spinous dorsal just preceding it, the highest rays $2\frac{1}{2}$ in head; anal rays low, the posterior ones slightly higher than the anterior ones, $3\frac{1}{2}$ in head; caudal rounded, $1\frac{3}{4}$ in head; pectoral rays

simple, the membranes incised between tips of 3 or 4 lower ones, fin rounded posteriorly, not quite reaching a vertical through anal opening; ventral spine as long as second ray, slender; rays 2, the first somewhat longer than the second.

Color, light brown, tinged with olive, a series of 9 or 10 dark vertical bands which are broadest near the middle, narrow or pointed below, encroaching above on basal part of dorsal fin; posteriorly the bands grow wider in proportion to length, the last one often represented by a round spot: a dark round spot on base of caudal; head and body with white specks, a group of them on base of pectoral, a row of prominent ones along middle of body; chin with large white blotches; branchiostegal region spotted with black; ocular tentacles dusky; lateral line white; dorsal with an oblong black ocellus in the region of the second spine; anterior part of fin dark, flaked with small, light spots, posterior part lighter, with 1 or 2 rows of narrow, oblong, vertical dark spots; rays with small black spots, the lower ones darker than the upper; 1 or 2 outer rays of caudal with dark specks; anal with a dusky

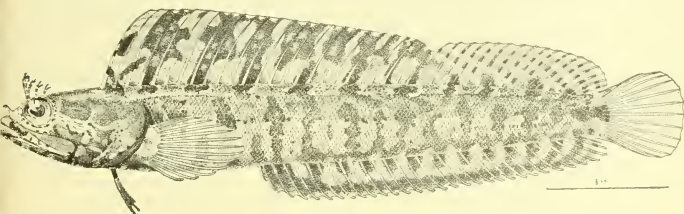


FIG. 3.—ZACALLUS BRYOPE.

subterminal margin, a row of indistinct, dusky spots along the base; pectoral with a small black spot on base; ventrals mostly dusky. Some specimens are lighter in color than the one described, but the general color-pattern remains about the same.

Type No. 7067, Zoological Museum, Stanford University, from Misaki, Japan. Cotype No. 50296, U.S.N.M.

We have very many specimens about 70 millimeters long from Misaki, Wakanoura, and Enoura. The species lives in the clear, warm tide pools with *Tripterygion thcostoma*, *Scartichthys enosima*, and *Blennius yatabei*.

(βρύον, moss; ὤπι, face.)

Fin-ray counts of *Zacalles bryope*:

Dorsal.	Anal.	Pectoral.
XXVI, 17	1, 31	13
XXVI, 18	1, 32	13
XXV, 18	1, 31	—
XXVI, 16	1, 31	13

3. BLENNIUS (Artedi) Linnæus.

Blennius ARTEDI, Genera Piscium, 1738, p. 27.

Blennius LINNÆUS, Syst. Nat., 10th ed., 1758, p. 256 (*galerita*).

Salarias FORSKÅL, Descr. Anim., 1775, p. 22 (*basiliscus*).

Pholis FLEMING, Brit. Anim., 1828, p. 207 (*levis=pholis*); not *Pholis* SCOPOLI, 1777.

Adonis GRONOW, Cat. Fish., Ed. Gray, 1754, p. 93 (*paroninus=ocellaris*).

Lipophrys GILL, American Naturalist, June, 1896, p. 498 (*pholis*).

Body oblong, compressed, naked; head short, the profile usually bluntly rounded; mouth small, horizontal, with a single series of long, slender, curved, close-set teeth in each jaw, besides which, in the lower jaw at least, is a rather short and stout fang-like canine tooth on each side; premaxillaries not protractile; gill-openings wide, extending forward below, the membranes free from the isthmus, or at least forming a broad fold across it; dorsal fin entire, or more or less emarginate, the spines slender; pectorals moderate; ventrals well developed, I, 3; no pyloric caeca; lateral line developed anteriorly. Species numerous, lurking under rocks and algae in most warm seas; some species in the lakes of northern Italy.

(*blennius*, the ancient name, from βλέννα, slime.)

4. BLENNIUS YATABEI Jordan and Snyder.

Blennius yatabei JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 374, pl. XIX; Misaki.

Head $3\frac{2}{3}$ in length; depth $3\frac{2}{3}$; depth of caudal peduncle $2\frac{2}{3}$ in head; eye $4\frac{1}{3}$; interorbital space 12; D. XII, 16; A. I., 19; P. 14.

Body rather short, compressed; the caudal peduncle deep, greatly compressed; snout short, blunt, its outline rising abruptly to border of eye; mouth slightly oblique, maxillary extending to a vertical through the posterior border of eye, shorter in some specimens; upper lips wide and thin, jaws equal; teeth in a single row in each jaw, curved, incisor-like, the cutting edges rounded, closely apposed to each other; two strong curved canines in each jaw, no teeth behind the canines; a single strong tooth on the vomer. Edge of shoulder-girdle without protuberances; gillrakers on first arch reduced to 5 or 6 small projections. Nostrils with low rims, the anterior one with a small cirrus; upper edge of eye with a long cirrus, one side of which is branched. Body naked; lateral line arched over the pectoral, the pores large and distinct anteriorly, becoming indistinct and finally disappearing on the posterior third of body. Dorsal extending from occiput to basal rays of caudal; a shallow notch between the spinous and soft part; the spinous part highest near the middle, about 2 in head; the last spine not reaching upward to edge of membrane, a peculiar character present in each specimen; longest rays somewhat higher than the spines. Anal in males bearing a large soft pad on first spine and ray, the membrane between them deeply incised; in females the spines and rays are all

similar; length of highest rays $2\frac{3}{4}$ in head; caudal rounded; pectoral rounded, membranes of 4 or 5 lower rays incised; ventral rays almost entirely connected by membrane.

Color in spirits, olive brown; body with small blackish spots, generally gathered in 3 groups, which are arranged in vertical rows, in some specimens appearing as 3 lateral rows of large blotches with small spots between them; membrane between first and second spines with a dark spot about as large as eye; 12 or 14 small dark spots along base of dorsal, sometimes absent on large examples; anal dark, the tips of rays white; pectoral dusky, the upper part lighter; in life the spots on lower part of body are yellowish, the throat suffused with pinkish, the tips of ocular tentacles brick red. Many specimens from Misaki, Enoshima, and Wakanoura have enabled us to add some-

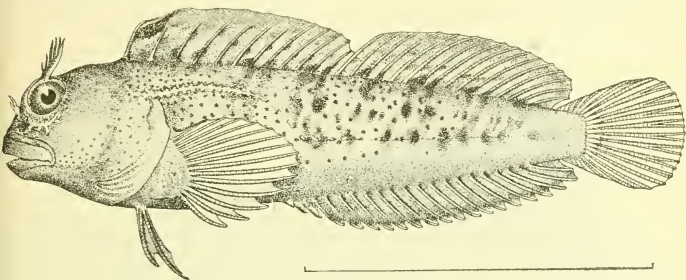


FIG. 4.—BLENNIUS YATABEI.

what to the original description. The species is common in the rock pools at the extremities of the headlands in southern Japan. It is especially abundant about the sacred island of Enoshima.

(“This species is named in memory of our old friend and college mate, Riokichi Yatabe, formerly professor of botany in the University of Tokyo, drowned in 1889 in a sad accident in the Bay of Kamakura, near Enoshima.”)

4. PETROSCIRTES Rüppell.

Petroscirtes RÜPPELL, Atlas Fische, 1828, p. 110 (*nitratius*).

Blemnechis CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1836, p. 279 (*filamentosus*).

This genus is closely allied to *Aspidontus*, differing chiefly in the elevated dorsal, the anterior spines especially being higher than the others. Certain minor characters also distinguish the species known to us. Tropical seas of Asia, living in the tide pools.

(πέτρος, rock; σκιρτάω, to leap.)

5. PETROSCIRTES ELATUS Jordan and Snyder, new species.

Head $4\frac{2}{3}$ in length; depth $3\frac{1}{3}$; depth of caudal peduncle $1\frac{2}{3}$ in head; eye $3\frac{1}{2}$; interorbital space 5; D. XII, 15; A. I, 16; P. 14.

Body short and deep; the head large, with a short, rounded snout; interorbital space broad, convex; jaws with a row of long, slender, curved, close-set teeth, followed on each side by a single strong canine; canines of lower jaw much longer than those of upper, fitting into pits in the upper jaw; tongue very short; valves of mouth far back; gill opening restricted to a slit about equal in width to the vertical diameter of eye; pseudobranchiae large; gill rakers on first arch 7 or 8, very small, pointed. Head and body naked; chin with a pair of short flaps; upper part of eye with a long flat filament; each side of neck with a small flap-like filament, below which is a minute villus. Lateral line incomplete, consisting of 3 or 4 long tubes extending upward and backward along base of anterior end of dorsal fin.

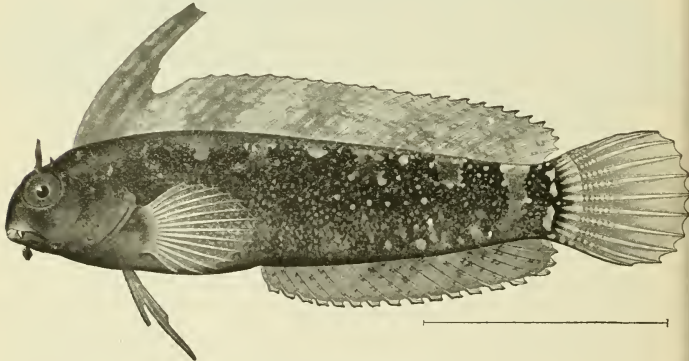


FIG. 5.—PETROSCIRTES ELATUS.

Dorsal inserted on nape, the anterior part elevated; the first spine highest, contained $3\frac{1}{2}$ times in the length; second spine of about equal height, the third much shorter, equal to the following ones, $6\frac{2}{3}$ in length; membrane between third and fourth spines with a deep scallop, notched between the following spines and rays, leaving the tips free; rays equal in length to the posterior spines; posterior rays of anal longest, $1\frac{2}{3}$ in head; a small fleshy knob at tip of each ray, except the last three; membrane incised between the rays; caudal rounded, $4\frac{1}{2}$ in the length, the membrane scalloped between the rays, leaving their tips free; pectoral rounded, its length $1\frac{1}{2}$ in head; middle ray of ventral long and filamentous, reaching the vent.

Color in spirits, brownish, the upper half of side with six indistinct blackish blotches; other parts of the body with rather indefinite dark specks; filaments on head blackish; anterior elevated part of dorsal

dusky, the other parts of fin with dusky clouds; rays of anal with dusky cross bands; caudal dark at base, the rays crossed by dark lines near their bases.

The species is known to us from a single specimen only, 71 mm. long. Type, No. 7071, Stanford University Zoological Museum, taken by Capt. Alan Owston at Yaeyama, Ishigaki Island, in the Riukiu Archipelago.

Dr. Ishikawa¹ notes a specimen in the Imperial Museum from Miyakoshima allied to the present species, under the name *Petroscirtes mitratus*, and an *Aspidontus* from the same island under the name of *Petroscirtes dispar* Günther, a name proposed originally for specimens from Amoy belonging to two distinct species.

(*elatus*, elevated.)

5. ASPIDONTUS Cuvier.

Aspidontus (Cuvier) QUOY and GAIMARD, Voy. Astrolabe, III, 1834, p. 719, (*terniatus*).

Omobranchus (Ehrenberg, pl. XI, f. 91) SWAINSON Class'n. Fishes, II, 1839, p. 274 (*fasciolatus*).

Body rather elongate, naked; mouth small, with a single series of immovable teeth in the jaws; behind this a strong, curved canine, those of lower jaw longer than those of upper; head sometimes with filaments; gill-opening reduced to a small fissure above the root of the pectoral; dorsal fin low, the anterior spines not elevated; air-bladder present; pseudobranchiae present; no pyloric cœca. Species numerous in the East Indian Seas.

(ἀσπίς, shield; ὀδούς, tooth.)

- a. Body yellowish, with blackish cross-bars anteriorly, and many black spots; teeth 18-18; D. XII, 22; A. 25.....*elegans*, 6
- aa. Body grayish with two broad lengthwise stripes of black; teeth 28; D. 10, 21; A. 20; caudal truncate.....*trossulus*, 7
- aaa. Body plain grayish or brownish, with no sharply defined marks.
- b. Teeth 26-28; head with faint dark bands; side with 4 dark lines anteriorly.....*dasson*, 8
- bb. Teeth 36-40; coloration plain.....*japonicus*, 9

6. ASPIDONTUS ELEGANS (Steindachner).

Petroscirtes elegans STEINDACHNER, Ichth. Beitr., V, 1876, p. 169; Nagasaki.

*Petroscirtes lineopunctatus*² (Genchenot Ms.) SAUVAGE, Bull. Sci. Philom., IV, 1880, p. 216; Japan; Coll. A. Étoffe.

¹ Prel. Cat., 1897, p. 35.

² The following is a translation of the description given by Dr. Sauvage:

Head 7 in total length; depth, 7; D. 34; A. 25. Snout anteriorly truncate, longer than the eye; lower posterior canine much larger than upper; no tentacle on the head; interorbital space convex, as broad as eye; caudal emarginate. Color brownish yellow, sown with many small black points, three black vertical bands on the head, and three of the same color on the anterior part of the trunk, these bands extending on the back; a black spot on the caudal peduncle; tips of rays of dorsal and anal blackish. Length, m. 0.080. Japan. A. Étoffe. (Sauvage).

Head 5 in length; depth $5\frac{1}{2}$; depth of caudal peduncle $2\frac{1}{2}$ in head; eye $3\frac{2}{3}$; snout 4; interorbital space 8; D. XII, 22; A. I, 24; P. 13.

Body moderately elongate, compressed; the caudal peduncle deep; head as deep as body; snout short, blunt; anterior profile steep, rounded above eye; jaws subequal, the lower slightly shorter than the upper; mouth horizontal, the cleft extending to a vertical through anterior edge of pupil; jaws with a series of long, slender, close-set teeth followed on each side by a single canine, which is separated from the others by a small space; canines of lower jaw much longer than those of upper; no teeth on vomer and palatines; teeth in each jaw numbering 18 besides canines; gill-opening restricted to a small space above base of pectoral; gillrakers on first arch reduced to 8 or 10 minute protuberances; no barbels on head. Head and body naked; no lateral line. Dorsals continuous; no notch between spinous and soft parts, inserted on nape anterior to a vertical through gill-opening, the last ray united by a membrane to base of caudal, the membrane slightly notched between the rays, spines somewhat higher than the

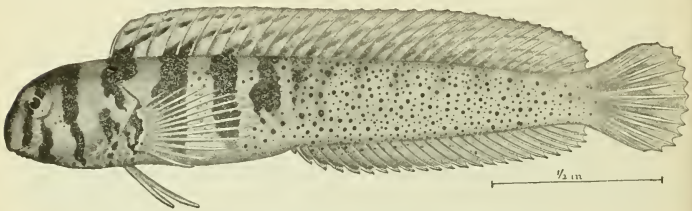


FIG. 6.—*ASPIDONTUS ELEGANS*.

rays, about $5\frac{1}{2}$ in the length of body; anal inserted below base of twelfth dorsal spine; last ray united by membrane to caudal peduncle; the membrane deeply notched between the rays; the posterior or longest rays contained about 9 times in the length; caudal rounded, the membrane slightly scalloped between the rays; pectoral rounded, slightly longer than the caudal, $5\frac{1}{2}$ in the length, the rays all simple; ventrals $1\frac{1}{3}$ in head.

Color in spirits, dull yellowish-olive, covered throughout with minute, round, black spots and specks, the anterior parts with vertical blackish bars, broad above, growing narrower and pointed below, the bars more distinct in the region of the pectoral, becoming narrower and shorter posteriorly and disappearing near middle of body. In different individuals the bars vary somewhat in shape and size, there always being one at insertion of dorsal, each space between the bars beneath the pectoral usually with a narrow dead white stripe; head with dark vertical bars, usually one on anterior part of snout, one passing through eye, another extending downward from lower margin of eye, and a fourth and broader bar posterior to the eye; spots of

throat elongate, in some places forming reticulations, the interspaces dead white; base of pectoral dead white with jet black spots or reticulations, in some cases yellowish-olive with black specks like posterior part of body; the 3 or 4 dark bars encroaching on anterior part of base of spinous dorsal, above which are a few indistinct, dusky, oblique bars; posterior part of dorsal with a few minute spots near the margin; anal with a narrow edge of white anteriorly, above which is a dusky band; a row of black points along anterior basal part of fin; other fins somewhat dusky. In life the vertical bands of body are a dark wine color, becoming greenish brown posteriorly, the spaces between with narrow greenish-white bands; base of pectoral and branchiostegal region with bluish-white reticulations; throat wine color; base of dorsal with a row of pearly spots, which show very indistinctly on the preserved specimen; posterior part of dorsal with a vinaceous edging; anal with 3 rows of small pearly spots, the posterior rays tipped with wine color.

This species is found about the rocky headlands of southern Japan. Our numerous specimens are from Misaki, Enoshima, Wakanoura, and Hakodate. It is one of the most prettily colored of little fishes.

(*elegans*, elegant.)

7. *ASPIDONTUS TROSSULUS* Jordan and Snyder, new species.

?? *Petroscirtes bankieri* RICHARDSON, Voy. Sulphur, Fishes, 1846, p. 136, pl. LXIV, figs. 8, 9; Hongkong.

Head $4\frac{1}{6}$ in length; depth $4\frac{3}{4}$; depth of caudal peduncle $2\frac{2}{5}$ in head; eye $3\frac{2}{3}$; interorbital space $3\frac{1}{8}$; snout $3\frac{1}{2}$; D. X. 21; A. I. 19; P. 13.

Body rather stout, compressed, the caudal peduncle deep; head large, broad, interorbital space wide and flat; eyes rather large, directed laterally; snout blunt; lower jaw a little shorter than the upper; mouth horizontal, the cleft extending to a vertical through center of pupil; jaws with a row of long, slender, close-set teeth, followed on each side by a canine separated from the others by a small space; canines of lower jaw very large and strong, fitting into a large pit in the upper jaw, a flap formed by an elongate upward extension from the lip at base of tooth; canine of upper jaw small, scarcely projecting beyond edge of middle teeth; vomer and palatines without teeth; teeth in each jaw numbering 28; tongue very short, ending far back in mouth; valve of roof of mouth located posteriorly; gill-opening restricted to a small slit above base of pectoral. Head and body naked, a pair of small, flat barbels on chin; a minute, slender barbel on upper part of eye; lateral line incomplete, extending near base of dorsal from above gill-opening to a point over tip of pectoral. Spinous dorsal continuous with the soft part, no notch between them, the membrane slightly incised between the rays; spines slender, flexible, the longest contained $1\frac{3}{4}$ times in head, longest rays $2\frac{1}{2}$; membrane of anal

scalloped between the rays, their tips free; length of highest rays $2\frac{1}{2}$ in head; the tips of upper and lower rays with short filaments; caudal truncate, length $1\frac{1}{2}$ in head; pectoral rounded, the rays simple, $1\frac{1}{2}$ in head; ventral about equal to pectoral in length.

Color, grayish with two lengthwise stripes of violet black; a broad blackish stripe extending from tip of snout to base of caudal, the width of stripe on anterior part of body equal to diameter of eye, one-half as wide immediately behind eye; a similar, though lighter stripe, extending from lower jaw through lower half of base of pectoral to base of caudal, the upper outline of this band distinct, the lower shading off into the bluish gray of the ventral region, the space between the two bands yellowish white; a narrow, dark band along anterior part of base of dorsal; chin and top of head dusky, the head with a few small black spots above eyes; dorsal with a broad dusky band along the basal half, the upper part with dark spots and reticulations; anal with 5 large dusky spots, the rays narrowly tipped with white; base of caudal with an indistinct vertical band of dusky; pectorals and ventrals light.

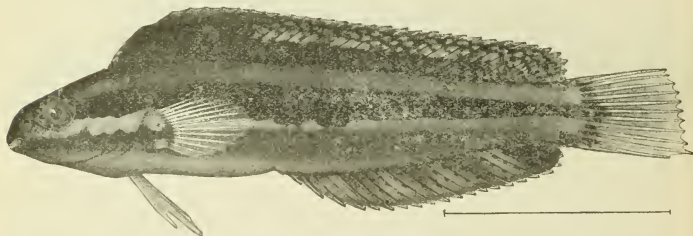


FIG. 7.—*ASPIONOTUS TROSSULUS*.

This species seems to be distinct from *P. bankieri*. It differs in color from the example described by Richardson, the latter having the median dark lateral band originating at gill-opening, the lower band absent, and the anal without the dark spots, there being instead a dark marginal band. Richardson states that his specimen was badly macerated.

We have one specimen 75 mm. long from Misaki. Numerous others 150 or 200 mm. long were seen in the deep rock pools, but they can be obtained only with great difficulty. It is one of the most beautiful as well as the most active of all the blennies.

(*trossulus*, a dandy.)

8. *ASPIONOTUS DASSON* Jordan and Snyder, new species.

? *Petroscirtes japonicus* BLEEKER, Kon. Ak. Wet. Versal. Amst. 2nd Rek., III, p. 246; Jedo.

Head $5\frac{1}{2}$ in length; depth $5\frac{2}{3}$; depth of caudal peduncle $2\frac{1}{3}$ in head; eye $3\frac{1}{2}$; interorbital space about 10; snout $3\frac{1}{2}$; D. XII, 22; A. I. 22; P. 13.

Body compressed, the caudal peduncle especially so; snout short, blunt; interorbital space narrow, convex; eyes directed somewhat obliquely; mouth small, the cleft extending to a point below anterior edge of orbit; lower jaw shorter than upper; lips with pendent flaps at bases of canine teeth, that of the lower lip the more prominent; jaws with a row of long, slender, close-set teeth, 26 in the upper, 28 in the lower series, followed by a single canine on each side, which is separated from them by a narrow space, the lower canines much longer than the upper, fitting into pits in the upper jaw; vomer and palatines without teeth; gill-opening restricted to a narrow slit above base of pectoral; pseudo-branchiae large; gillrakers on first arch 8 or 10, very small.

Head and body naked, no filaments on head; lateral line incomplete, the pores extending along upper part of body to a short distance beyond tip of pectoral from whence the lateral line is indicated by a row of slight pits or scars which bends downward and extends along middle of body to base of caudal.

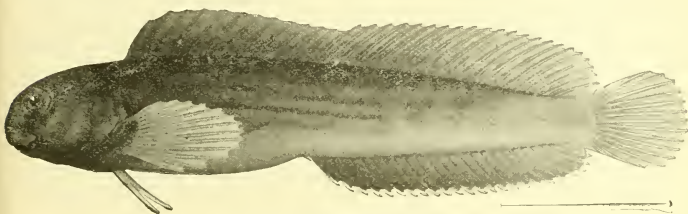


FIG. 8.—*ASPIDONTUS DASSON*.

Dorsal inserted above gill-opening, membrane of posterior ray reaching base of caudal fin; margin of fin with shallow scollops between the rays, posterior half of fin higher than anterior half, the longest ray contained $1\frac{1}{4}$ times in head; anal lower than dorsal, the longest rays 2 in head, membrane notched between the tips of rays; caudal rounded, $1\frac{1}{5}$ in head; pectoral rays simple, the fin rounded, equal in length to head; ventrals short, nearly 2 in head.

Color in spirits brownish, darker anteriorly than posteriorly; side with 4 dark lines extending about halfway back; 1 or 2 indistinct, oblique dark bands on head, the anterior one passing through eye; fins dusky, without spots or bands; rays of anal tipped with white.

We should identify our specimens with *Petroscirtes japonicus* were it not that Bleeker states in his description that the teeth in the jaws number from 36 to 40, while our specimens have but 26 to 28. It is not easy to suppose that Bleeker should have made an error in counting these teeth, though he might have done so in copying his notes. In his brief description no other difference appears.

We have 2 specimens about 60 mm in length from Wakanoura, and a

smaller one from Agu in Shima. The former is Type No. 7070, Stanford University Zoological Museum; the other is Co-type No. 50300, U.S.N.M.

(ἀσσῶν, very swift.)

9. ASPIDONTUS JAPONICUS Bleeker.

Petrosirtes japonicus BLEEKER, Versl. Kon. Ak. Wet. Amst., III, 1869, p. 246; Jedo.

The following is the substance of Bleeker's description of this fish, which may be the same as our *Aspidontus dasson*.

Head $6\frac{1}{3}$ with caudal, about 5 without; depth $6\frac{1}{3}$ in total (5 to base of caudal); D. XI, 21; P. 13; A. 25.

Body elongate, compressed; forehead above eye very convex; no cirri on occipital crest; eye $4\frac{1}{2}$ in head, less than a diameter apart; snout obtuse but not convex, prominent before the eyes; victus extending to below front of eye; teeth in each jaw close set, obtuse, 36 to 40 in number; a curved posterior canine on each side, the lower canine more than twice as long as the upper; gill opening not smaller than eye; lateral line conspicuous anteriorly; dorsal entire, the spines low, growing progressively longer behind; pectoral rounded, 6 in total length; ventral 11 in length; caudal $6\frac{1}{3}$.

Color dusky reddish, paler below; fins dull orange; iris green. Described from a specimen 83 mm. long, from Yedo (Tokyo). Were it not for the number of teeth counted by Bleeker, we should unhesitatingly identify it with *Aspidontus dasson*.

6. SALARIAS Cuvier.

Salaria CUVIER, Règne Anim., 2d ed., 1829, p. 175 (*quadripinnis*).

This genus differs from *Scartichthys* in having the dorsal fin continuous, without notch; no posterior canines.

(σαλαρία, a modern Greek name of *Blennius basiliscus*.)

10. SALARIAS CERAMENSIS Bleeker.

Salaria ceramensis BLEEKER, Ceram, II, 1852, p. 701; Ceram, Celebes, Boro.—GÜNTHER, Cat. Fish., III, 1861, p. 246; Ceram.

Head 5 in length; depth $3\frac{2}{5}$; depth of caudal peduncle $2\frac{1}{2}$ in head; eye $3\frac{1}{5}$; interorbital space $6\frac{2}{5}$; D. XII, 19; A. I, 19; P. 14.

Body deep and greatly compressed; head small, short, blunt, the anterior profile blunt; eye large, its diameter twice width of sub-orbital, located in upper, anterior part of head; mouth horizontal, lower jaw somewhat shorter than upper; teeth in a single row in each jaw, minute, slender, close-set, loosely embedded in the fleshy gums, no canines; gill-membranes forming a broad fold across the isthmus; gill-rakers on first arch minute, pointed; pseudobranchiæ well developed,

a row of cilia resembling gillrakers along the base; upper edge of eye with a many-branched cirrus, the height of which is less than diameter of eye; a short, flat, fringed tentacle on each side of nape.

Head and body naked; lateral line high on body, incomplete, following contour of back to a point about opposite tip of pectoral, where it ends.

Spinous and soft dorsals continuous, not separated by a notch, the last ray united with upper edge of caudal by a membrane; spines with flexible tips, the highest contained $1\frac{1}{3}$ times in head; rays higher than the spines, about $1\frac{1}{2}$ in head; membrane of anal incised between the rays, leaving their tips free, the longest contained $1\frac{1}{2}$ times in head; caudal convex; pectoral rounded, slightly longer than head, the membrane incised between all the rays, the lower rays somewhat enlarged; ventrals $1\frac{2}{3}$ in head.

Color in spirits, brownish; the sides with many dark, longitudinal lines which are broken up into dots on the upper anterior parts; head with small spots, or dots, on the upper surface; spinous dorsal with small blackish spots and dots inclosing a number of oblong, colorless areas; soft dorsal with many elongate black spots near edge and base of fin; anal with a basal row of 8 or 9 spots, above which are a few dots; caudal with dots on base and along the middle; pectoral with 3 vertical rows of dots; ventrals with 2 or 3 rather large spots.

One specimen of this species was taken by Capt. Alan Owston at Yaeyama, Ishigaki Island of the Riukiu Archipelago. It was previously known only from the East Indies.

(Name from the island of Ceram.)

7. SCARTICHTHYS Jordan and Evermann.

Scartes JORDAN and EVERMANN, Check-List Fishes, 1896, p. 471 (*rubropunctatus*); preoccupied by *Scartes* Swainson, a genus of mammals.

Scartichthys JORDAN and EVERMANN, Fish N. and M. Amer., III, 1898, p. 2396 (*rubropunctatus*).

Body elongate, slowly declining to the caudal; head obliquely compressed, oblong, the profile more or less vertical; eyes lateral, closely approximated, situated at the angle of the profile with the postocular region; usually a cirrus above the eye; gill apertures continuous under the throat, gill membrane free from isthmus; branchiostegals 6; mouth moderate, the contour of the upper jaw semicircular; upper jaw protruding beyond the lower; lips moderate, uniform, and free, concealing the teeth; teeth labial and movable, very slender and recurved, contiguous and uniserial; no posterior canines; dorsal fin divided; anal similar to soft dorsal; caudal obtusely rounded; pectorals moderate, angularly rounded; ventrals approximated, each with 3 simple rays, the internal of which is smallest.

Found in the rock pools of the Pacific, widely distributed.

(σκάρτιης, one who leaps; ἰχθύς, fish; the fish having extraordinary powers of throwing itself from pool to pool by leaping into the air when the tide recedes.)

- a. Head with a high dermal crest at the nape; dorsal rays, XIII, 21; anal, 23; color, dark brown, with vertical bands of shining greenish.....*enosimæ*, 11,
 aa. Head without dermal crest; dorsal rays XII, 16; anal, 20; color brown, with dark cross bands and numerous white dots*stellifer*, 12.

II. SCARTICHTHYS ENOSIMÆ Jordan and Snyder, new species.

KAËRU-UWO (FROG-FISH).

Head $5\frac{1}{10}$ in length; depth $4\frac{9}{10}$; depth of caudal peduncle 2 in head; eye $4\frac{1}{2}$; interorbital space 13; D. XIII, 21; A. I, 22; P. 14.

Body somewhat elongate, compressed, the caudal peduncle deep, greatly compressed; head blunt, the anterior profile vertical; eye high up and far forward, directed somewhat obliquely; mouth horizontal, on lower part of head; suborbital area about as wide as orbit; upper

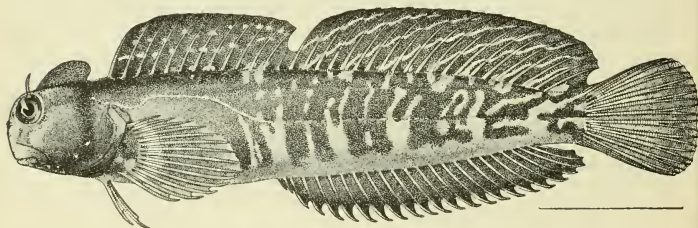


FIG. 9.—SCARTICHTHYS ENOSIMÆ.

lip wide, very thin; lower jaw included; cleft of mouth extending to a vertical passing a little behind orbit; teeth minute, slender, very loosely attached to the fleshy gums in a single row; close together like the teeth of a comb, some projecting slightly farther than others at the tips; no canines; no teeth on vomer or palatines; gill-membranes forming a broad fold across the isthmus; anterior edge of shoulder girdle without protuberances; gillrakers minute, slender, pointed; pseudobranchie large; a row of papillæ resembling gillrakers extending along base of pseudobranchie and downward toward attachment of first gill-arch; anterior nostril with a many-branched cirrus; upper part of eye with a tall, flat, pointed cirrus, its length equal to vertical diameter of eye; occiput with a tall, thin, crest-like flap which extends from interorbital space to nape, its height equal to vertical diameter of orbit; a minute, slender cirrus on each side of nape. Head and body naked; lateral line arched over pectoral, the curve parallel with outline of fin, distinct anteriorly, breaking up near middle of body, becoming indistinct and disappearing posteriorly. Dorsal fin extend-

ing from nape to base of caudal, the spinous part separated from the soft part by a deep notch; spines slender, very flexible, highest a little anterior to middle of fin, $1\frac{3}{5}$ in head; longest rays somewhat higher than the spines; membrane of soft dorsal slightly incised between the rays, connecting posteriorly with upper ray of caudal; anal rays with the membrane thickened about them, especially the anterior ones which have thick, corrugated pads; membrane of anal deeply incised between the rays, not connecting posterior ray with caudal peduncle; caudal rounded, its length equal to $\frac{7}{8}$ of head; pectoral acutely rounded, rays simple, the lower ones slightly thickened; membrane of fin incised between the five lower rays; ventrals $1\frac{1}{2}$ in head.

Color in spirits, light brownish, much darker above; on posterior surface of body the light color extends upward in irregular clouds on the darker portion, a few round or irregularly shaped spots between and above the cloud-like marks; dorsal blackish, the spinous part with 2 rows of indistinct light spots, the soft part with oblique, wavy, light lines, broader below, growing narrower toward margin of fin; anal, caudal, and pectoral fins plain blackish.

Here described from a specimen 120 mm. long, collected at Misaki. Type No. 7068, Zoological Museum, Stanford University. Cotype No. 50297, U.S.N.M.

Color in life, reddish brown with narrow vertical bands and reticulations of pale green; dorsal suffused with reddish brown; narrow, longitudinal, greenish bands or lines along its upper part.

The following counts are of other specimens:

Dorsal,	Anal,	Pectoral,
Enoshima XII, 20	I, 19	14
XII, 20	I, 20	13
Misaki XIII, 21	I, 19	14
XII, 21	I, 20	14
XIII, 21	I, 21	14

This species was taken by us only in the deep rock-pools adjoining the sacred cave of Benten on the island of Enoshima, and in rock-pools of Yogashima, an island at Misaki. In both places it is abundant, feeding on algae.

(*e-no-shima*, island of the bay.)

12. SCARTICHTHYS STELLIFER Jordan and Snyder, new species.

Head $4\frac{1}{2}$ in length; depth $4\frac{1}{2}$; depth of caudal peduncle $9\frac{1}{2}$ in head; eye $4\frac{1}{2}$; interorbital space 9; D. XII, 16; A. I, 19; P. 14.

Body elongate; caudal peduncle much compressed; head short, blunt, the anterior profile almost vertical; eye high up and very far forward; suborbital area equal in width to diameter of eye; mouth horizontal, inferior, the upper jaw projecting; cleft of mouth extend-

ing to a vertical through posterior border of orbit; teeth long, slender, loosely attached to the fleshy gums, in a single row, close-set like the teeth of a comb; no canines; gill-membranes forming a broad fold across the isthmus; anterior edge of shoulder girdle without protuberances. Pseudobranchiae large; a row of slender papillae similar to gillrakers extending along base of pseudobranchiae downward to attachment of first gill-arch. Gillrakers on first arch small, slender, pointed; nostril with a small, flat, branched cirrus; a pointed, flat cirrus attached on one side to upper part of orbit, on the other to the skin of interorbital area, its height $1\frac{2}{3}$ in head; a minute cirrus on each side of posterior part of occiput; no dermal crest on head.

Head and body naked; lateral line complete, arched over the pectoral, a distinct thread-like ridge anteriorly, broken up into separate pores posteriorly.

Dorsal fin extending from nape to caudal peduncle, a deep notch between spinous and soft parts; anterior half of spinous dorsal highest, $1\frac{3}{4}$ in head; longest dorsal ray $1\frac{1}{2}$ in head; membrane of dorsal not

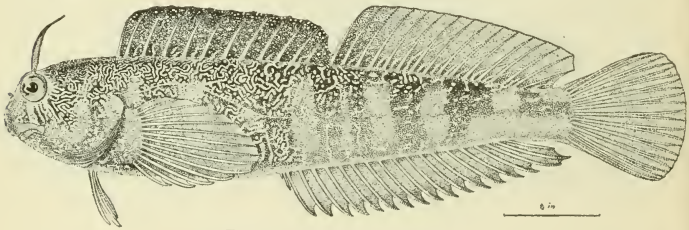


FIG. 10.—SCARTICHTHYS STELLIFER.

incised between the rays, the last ray connected with caudal peduncle by membrane; membrane of anal deeply incised between the rays; longest ray $1\frac{2}{3}$ in head; the first two rays very short; caudal rounded, about equal to head in length; pectoral acutely rounded, the rays simple, the membrane notched on the lower border; ventrals $1\frac{2}{3}$ in head.

Color in spirits, light brown, with 7 more or less distinct cross-bands on side of the body; head and body dotted and penciled with white, subdued on the upper anterior parts, sharp and distinct posteriorly and on throat and breast; spinous dorsal blackish, speckled with white; an oval black spot between first two spines; soft dorsal with white dots and lines, running transversely; anal with a white vertical line on base of fin between each 2 rays, outer part of anal with elongate white spots; caudal dusky, with white specks; pectoral plain. A small specimen has the anal rays tipped with white.

Three specimens of this species were taken in the rock pools at Wakanoura. Type No. 7069, Stanford University Zoological Museum, from Wakanoura. Cotype No. 50298, U.S.N.M.

(*stella*, a star; *fero*, I bear.)

8. AZUMA Jordan and Snyder.

Azuma JORDAN and SNYDER, new genus of Blenniidae (*emmnion*).

This genus is closely allied to *Bryostemma*, differing chiefly in having the cheeks and upper parts of head covered with fine scales. Body covered with small, smooth scales; lateral line represented by a short row of pores above pectoral; top of head, cheeks, and chin with tentacles; teeth in two closely apposed rows, arranged alternately, the tips meeting on a line so as to form a single cutting edge; dorsal fin of spines only. Coasts of Japan, descending into deep water.

(*Azuma*, a poetical name for the eastern part of the island of Hondo.)

13. AZUMA EMMNION Jordan and Snyder, new species.

Head $6\frac{1}{2}$ in length; depth 5; eye 4 in head; interorbital space $9\frac{1}{2}$; snout $4\frac{1}{2}$; D. 61; P. 14; A. I. 45.

Head small, short, blunt; jaws equal, the lower sometimes projecting slightly; maxillary extending to a vertical through posterior part of pupil; teeth in two closely apposed rows, arranged alternately, the

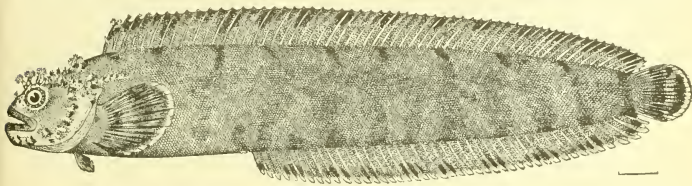


FIG. 11.—AZUMA EMMNION.

points aligned so as to form a single cutting edge, short, flat, with acutely rounded tips; no teeth on vomer or palatines; tongue thick and blunt; gill membranes united, forming a broad fold across the isthmus; pseudobranchiae large; a number of papillae resembling gill rakers extending downward from base of pseudobranchiae; gill rakers on first arch 6+11, short, thick, pointed.

Body covered with very small, elongate, cycloid, deeply embedded scales; cheeks, opercles, and upper parts of head with minute scales; membranes of dorsal fin, basal parts of anal, and pectoral with scales; lateral line represented by a short row of pores above pectoral fin, the anterior pores each having a short tentacle; head with numerous cirri, broad and fleshy at the base, pointed or branched at the tip, 2 pairs on interorbital space, the anterior ones longer than the others, united at their bases, the posterior pair separated by a small pointed cirrus; 12 or 14 smaller cirri on occiput; a row of short, branched cirri extending backward along lower jaw and upward on edge of preopercle; 3 or 4 similar ones on opercle near upper edge of gill opening; 2 small barbels on throat; anterior nostrils with large, pointed tubes.

Dorsal inserted above a point half-way between occiput and gill-opening, united posteriorly with the caudal; the spines stiff and pungent, those near middle of fin contained about $2\frac{1}{3}$ times in head; membrane of fin fleshy, not incised between the spines; two anterior spines with short, branched cirri; anal united with caudal; the longest or posterior rays $2\frac{1}{3}$ in head; the membrane deeply incised between the rays; caudal rounded, the rays of the lower half slightly longer than those of the upper: length of fin $1\frac{1}{2}$ in head; pectoral rounded, $1\frac{1}{6}$ in head; ventrals somewhat longer than diameter of eye.

Body clouded with brownish black; 10 blackish spots as large as eye along upper part of body joined to vertical, dark bands on the dorsal; 11 or 12 indistinct, broad, vertical bands on lower half of body, 10 of which are above the anal and encroach on the fin, forming distinct, blackish blotches; caudal with 2 broad, vertical, blackish bands, the interspaces and the posterior border of fin white; pectoral clouded with blackish, the edge white; ventrals blackish, edged with white; head mottled, the chin and throat white.

Described from type, No. 7137, Ichthyological collections, Stanford University, a specimen about 250 mm. long from Hakodate. The cotype in the National Museum is numbered 50280. Other specimens measure 400 mm.

Collected at Same, Hakodate and Miyako, the specimen from Miyako presented by Mitonubu Irako, director of the Museum of Morioka.

Dorsal spines.	Anal rays.	Locality.
60	45	Same.
60	45	Hakodate.
61	45	Do.
61	45	Do.
60	45	Miyako.

(*év*, in: *μνίον*, moss.)

9. BRYOSTEMMA Jordan and Starks.

Bryostemma JORDAN and STARKS, Proc. Cal. Ac. Sci., 1895, p. 841 (*polyactocephalum*).

Body moderately elongate, covered with small scales; head naked; snout short; no teeth on vomer or palatines; teeth in jaws arranged alternately in 2 closely apposed series, the points aligned to form a single cutting edge; gill-membranes united, free from the isthmus; nostrils, orbital region and neck with dermal flaps, the supraorbital flaps high; dorsal fin long, of spines only; pectorals well developed, more than half length of head; ventrals well developed, jugular; caudal fin distinct; no air-bladder; pyloric caeca present; no true lateral line; a short series of large pores above pectoral. North Pacific, representing *Chirolophis* of the Atlantic. This genus differs from the European genus, *Chirolophis* Swainson (*Blenniops* Nilsson), in the

absence of a true lateral line. Dr. Boulenger informs us that a true median lateral line is developed in *Chirolophus ascanii*.

(βρῦον, moss; στέμμα, crown.)

a. Anal rays, I. 45.

b. Body with diffuse spots. Dorsal LIX *polyactcephalum*, 14.

bb. Body brightly colored, with 10 or 11 dark bars; fins barred; dorsal, LXI; anal, I. 45. *otohime*, 15.

aa. Anal rays I. 36; body speckled; dorsal LI *saitone*, 16.

14. BRYOSTEMMA POLYACTOCEPHALUM (Pallas).

Blennius polyactcephalus PALLAS, Zool. Rosso-Asiat., III, 1811, p. 179; Kamchatka.

Chirolophus japonicus HERZENSTEIN, Mélanges Biologiques, XIII, 1890, p. 123; Hakodate.

Bryostemma polyactcephalum JORDAN and GILBERT, Rept. Fur-Seal Investigations, Pt. 3, p. 479 (in part.)

Head $6\frac{2}{3}$ in length; depth $4\frac{2}{3}$; depth of caudal peduncle $2\frac{2}{3}$ in head; eye $3\frac{2}{3}$; snout 4; D. LIX; A. I. 45.

Body long, compressed, deep; head short, the snout blunt; interorbital space concave, the eyes projecting above the top of head; lower jaw projecting somewhat; maxillary extending to a vertical passing through middle of eye. Jaws with 2 closely apposed rows of teeth, arranged alternately, the tips aligned to form a single cutting edge; vomer and palatines naked; pseudobranchiæ large; gill-rakers on first arch 18, short, pointed.

Head naked; body covered with minute, partly embedded scales; membranes of fins naked, except basal part of pectoral. Lateral line represented by a series of 7 or 8 pores above opening of pectoral fin. Head with cirri; a small flat one between and a little posterior to the nostrils; 2 pairs of branched tentacles on interorbital space, the anterior of which are joined at their bases, the posterior ones widely separated, higher than the anterior pair; occiput with many small cirri, some of which are branched, others simple; lower jaw with a row of small, widely spaced cirri, which extends backward and upward along edge of preopercle; a few cirri above the short lateral line. Nostrils with long, pointed tubes.

Dorsal inserted immediately above the gill-opening, the first spine separated from the others by a deep scallop, several small cirri along sides of spine; the first and second spines with broad, branched flaps on their tips; membrane of fin not incised between the spines, connected with basal part of the caudal; height of middle spines contained $2\frac{2}{3}$ times in head. Membrane of anal deeply incised between the rays, narrowly connected with the base of caudal; rays near middle of fin contained $2\frac{1}{2}$ times in head; caudal rounded, the rays below the middle slightly longer than those above, $2\frac{1}{2}$ in head; pectoral rounded, equal in length to the head; ventrals $2\frac{1}{2}$ in head.

Color, brownish, throat and chin light yellowish; dorsal and anal dark toward the edge, the anal rays tipped with whitish; an indistinct, dark spot on posterior end of dorsal, extending downward on the body; caudal with 3 indistinct, vertical, dark bands; pectoral narrowly edged with soiled white.

Described from a specimen about 240 mm. long from Petropaulski Harbor, Alaska. Not seen by us in Japan though recorded by Herzenstein from Hakodate. The species is abundant on the west side of Bering Sea. The specimens from Alaska referred to this species belong to others as yet undescribed.

(πολύς, many; ἄκτις, ray; κεφαλή, head.)

15. *BRYOSTEMMA OTOHIME* Jordan and Snyder, new species.

Head $5\frac{2}{3}$ in length; depth $5\frac{2}{5}$; depth of caudal peduncle 3 in head; eye $3\frac{1}{2}$; interorbital space $6\frac{1}{2}$; snout $3\frac{3}{4}$; D. 61; A. I, 45; P. 15.

Body deep, generally compressed, lower jaw projecting slightly beyond the upper; maxillary extending to a point below posterior part of pupil; teeth of jaws in 2 rows anteriorly, in a single row on poste-

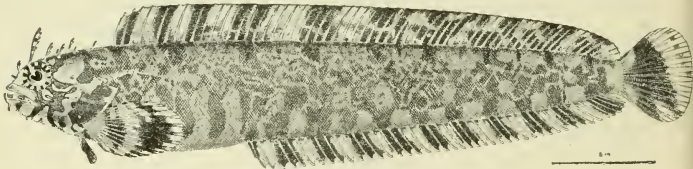


FIG. 12.—*BRYOSTEMMA OTOHIME*.

rior part of jaws, arranged alternately, the points aligned to form a single cutting edge; no teeth on vomer and palatines; tongue broad and rounded; gill-membranes forming a fold across the isthmus; pseudobranchiae large, the filaments as long as those of the gills; a row of cirri resembling gillrakers along their base; gillrakers on first arch about 4 + 11, short, pointed; pyloric caeca present.

Body covered with minute, close-set, cycloid scales; head naked. A small, median cirrus on upper part of snout; 2 pairs on interorbital space, the anterior of which are joined at the base, tall, slender, branched; those of occiput and nape small, slender; a small pair on chin, another on side of throat posterior to these; lateral line represented by a short row of pores above pectoral fin, the pores not extending back as far as tip of fin.

Dorsal inserted above gill-opening, connected with the base of caudal posteriorly, formed of spines throughout, the highest or anterior ones $2\frac{1}{4}$ in head, tips of anterior 4 or 5 rays free, with cirri; the membrane not incised between the rays; anal low, the rays scarcely longer than diameter of eye; the membrane deeply incised between rays;

membranes of dorsal and anal without scales; caudal bluntly rounded, its length, $1\frac{1}{2}$ in head; pectoral rounded, the membrane incised between the rays, $1\frac{1}{2}$ in head; ventrals, 3 in head.

Dorsal part of body with 10 or 11 narrow, vertical bars, corresponding in position with an equal number of large, dark blotches on the dorsal fin; ventral part of body with 10 broad, vertical bars, corresponding with as many large black spots on the anal; the ventral bars separated by white spots which alternate in position with a row of similar spots near middle of body, these in turn separating dark bars, the downward projections of the dusky color of the dorsal parts; head barred and mottled with brownish black, a distinct, dark bar extending downward from eye; cirri with small cross-bars; caudal with a large median black blotch, the base and edge white; pectoral clouded with dusky, edged with white; ventrals dusky, edged with white.

Described from a specimen 82 mm. long. Type, No. 7073, Stanford University Zoological Museum, from Hakodate. Many other examples from the same locality show some variation in brightness of color, the pattern being the same. Some of these cotypes are numbered 50302 in the United States National Museum.

Five specimens show a variation of from 60 to 62 dorsal spines and 45 to 46 anal rays.

(*Otohime*, a princess of Japanese fishes.)

16. BRYOSTEMMA SAITONE Jordan and Snyder, new species.

Head $5\frac{1}{2}$ in length; depth $5\frac{3}{4}$; depth of caudal peduncle $3\frac{1}{2}$ in head; eye $3\frac{3}{8}$; interorbital space 10; snout $4\frac{1}{2}$; D. 51 (?); A. I, 36.

Eyes large, placed far forward; snout short, the suborbital space narrow; lower jaw slightly longer than the upper; maxillary extending to a point below pupil; teeth small, close set, in two rows anteriorly, the teeth alternating in position, the tips aligned so as to form a single cutting edge; no teeth on vomer or palatines; pseudobranchiae present; gillrakers short, pointed; gill-membranes forming a fold across the isthmus; head naked; body covered with minute, cycloid scales. Lateral line represented by a short series of pores above anterior part of pectoral fin; a row of large mucous tubes below eye, passing backward above cheek to upper edge of gill opening; anterior nostril with a long tube; interorbital space, occipital part of head, and nape with long, branched tentacles, the length of the highest, which is above orbit, slightly greater than the diameter of eye. Dorsal inserted above gill opening, composed of rather strong, curved spines, the longest $2\frac{1}{4}$ in head; both dorsal and anal probably connected with caudal; ventrals jugular, 3 in head.

The only specimen which we have of this species is in such a poor state of preservation that accurate statements concerning the lateral line, the extent of the scaly covering, the tentacles of the head, the

shape and character of the fins, and points of less importance can not be made; the caudal fin is entirely gone.

Color, pale olive, with small, indistinct, brownish spots; a row of dark brown spots about the size of eye along body at base of dorsal, a row of smaller ones along middle of body, and a similar row along base of anal, the latter extending outward to the fin; belly plain; a dark spot extending downward from eye.

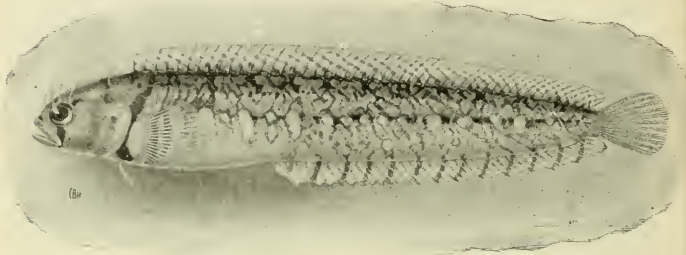


FIG. 13.—*BRYOSTEMMA SAITONE*.

The species may be distinguished from *B. otohime* by the more subdued coloring of the body, and the shorter anal fin, this fin in the latter species having 45 rays.

We have one specimen, 95 mm. long, from Aomori, presented by Mr. Sotaro Saito, director of the Museum of Aomori, for whom the species is named.

Type.—No. 7072, Stanford Zoological Museum.

10. *ENEDRIAS* Jordan and Gilbert.

Enedrias JORDAN and GILBERT, in Jordan and Evermann, Fishes North and Mid. Amer., III, 2414, 1898 (*nebulosus*).

This genus differs from *Pholis* in the scaly head.
(*ἐνέδρα*, lurking place.)

17. *ENEDRIAS NEBULOSUS* (Schlegel).

GINPO (SILVER TAIL).

Gunnellus nebulosus SCHLEGEL, Fauna Japonica, Poiss., p. 138, 1846, pl. LXXIII, fig. 2; Bay of Mogi, near Nagasaki.

Centronotus nebulosus STEINDACHNER, Ichth. Beitr., IX, 1880, p. 24; Gulf of Strielok, near Vladivostok.—NYSTROM, Svensk. Vet. Handl., 1887, p. 37; Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 35; Tokio, Hokkaido.

Muranooides nebulosus, STEINDACHNER, Reise II. M. S. Aurora, 1898, p. 213; Kobe.
Enedrias nebulosus, JORDAN and GILBERT, Rept. Fur Seal Invest., 1898, p. 482; Hakodate, Tokyo.—JORDAN and EVERMANN, Fish. N. and M. Am., III, p. 2414; Hakodate.

*Centronotus crassispina*¹ SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 139; Nagasaki.

Centronotus subfrenatus GILL, Proc. Ac. Nat. Sci. Phila., 1859, p. 146; Shimoda.

Head $8\frac{1}{2}$ in length; depth $6\frac{2}{3}$; depth of caudal peduncle 3 in head; eye $5\frac{2}{3}$; snout $5\frac{1}{2}$; interorbital space 10; D. LXXXI; A. II, 39; P. 15.

Head very small; body elongate, greatly compressed posteriorly; eye rather low in head, the interorbital space greatly arched; lower jaw projecting slightly beyond the upper, maxillary extending to a vertical through anterior edge of orbit; teeth short, blunt, in narrow bands on both jaws, more numerous on the upper, a few minute teeth on the vomer; gillrakers 2+10, slender, pointed.

No lateral lines; body covered with minute cycloid scales, which grow outward on membranes of dorsal and anal fins; head completely covered with similar scales except on interorbital space; no tentacles on head; nostrils with small tubes; dorsal with short, rigid, pungent spines, the first ones scarcely longer than diameter of pupil, the pos-

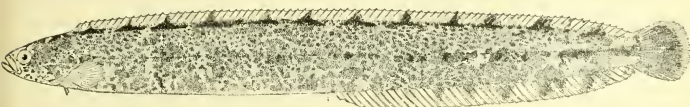


FIG. 14.—ENEDRIAS NEBULOSUS.

terior ones 4 in head; anal with 2 strong spines, the longest rays $3\frac{1}{2}$ in head; membrane of fin slightly scalloped between the rays, connected with the base of caudal, as is also that of the dorsal; caudal rounded, $1\frac{1}{2}$ in head; pectoral narrow, rounded, $2\frac{1}{2}$ in head; ventrals very small, the spines prominent, equal in length to first spine of dorsal.

Color, variously mottled or blotched with brownish or blackish on a yellowish-olive background; upper third of body having the color darker than the lower parts; a dark stripe extending downward from eye and upward over interorbital area; dorsal and anal blotched like the body.

Color in life, body mottled with olive-brown, more or less flushed with yellowish; belly orange, often very bright; head yellowish-brown

¹The following is the substance of Schlegel's account of *crassispina*, a form which we can not separate from *nebulosus*.

D. LXXVIII; A. II, 40.

Body greatly compressed, the greatest depth in the region of the anal opening, contained 8 times in the length; head 9 in length; teeth numerous; scales minute, delicate, deeply imbedded; dorsal composed of strong spines, somewhat curved, beginning above the pectorals, extending to caudal; the anal begins below the forty-first spine of the dorsal and extends to the caudal; caudal resembling that of *E. nebulosus*, except that it is a little larger; pectorals also similar to those of that species.

Color in spirits, uniform pale reddish brown, darker along the base of the dorsal; fins bordered with yellowish. (Schlegel.)

This species differs from *E. nebulosus*, according to Schlegel, in having a smaller head, larger eyes, more strongly curved spines, and a lighter color.

and black; dorsal edged with dull crimson; pectoral and lower half of anal scarlet; caudal dull orange.

Northern Japan; abundant in all the bays of Hondo and Hokkaido. Our numerous specimens are from Hakodate, Aomori, Otaru, Matsushima, Tokyo, Misaki, and Onomichi.

(*nebulous*, clouded.)

11. PHOLIS (Gronow) Scopoli.

Pholis GRONOW, Zoophylaceum, 1765, p. 78 (not binomial).

Pholis SCOPOLI, Introd. Hist. Nat., 1777, p. 456 (*gunnellus*).

Muraenoides LACÉPÈDE, Hist. Nat. Poiss., II, 1800, p. 324 (*sujef*).

Centronotus BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 165 (*fasciatus*).

Dactyleptus RAFINESQUE, Anal. de la Nature, 1815, p. 82; substitute for *Muraenoides*.

Centronotus CUVIER, Règne Animal, 2d ed., II, 1829, p. 239 (*gunnellus*).

Ophiomus SWAINSON, Nat. Hist. Class'n Anim., II, 1839, p. 277 (*gunnellus*).

Urocentrus KNER, Sitzber. k. Akad. Wissen. Wien, LVIII, 1868, p. 51 (*pictus*).

Rhodymenichthys JORDAN and EVERMANN, Check-List Fishes, 1896, p. 474 (*ruber-rinus*=*dolichogaster*).

Body long and low, considerably compressed, somewhat band-shaped, the tail slowly tapering; head small, compressed, naked; mouth rather small, oblique; jaws with rather small teeth in narrow bands or single series; vomer and palatines usually toothless; gill-membranes broadly united, free from the isthmus; scales very small, smooth; no lateral line; dorsal fin long and low, beginning near the head, composed entirely of stiff, sharp, subequal spines; anal similar in form, of 2 spines and many soft rays; caudal fin short and small, more or less joined to dorsal and anal; pectorals rather shorter than head; ventrals very small, of 1 spine and a rudimentary ray; intestinal canal short, without caeca.

Shore fishes of the Northern seas. (*φωλίζς*, name of some fish said to shelter itself when lying in wait by producing a cloud of mucus; *φωλάςς*, one who lies in wait.)

- a. *Urocentrus*: Pectoral fin small, $3\frac{1}{2}$ to 4 times in length of head; dorsal spines about 93; anal rays, 48; body with 2 rows of dark blotches; fins nearly plain *pictus*, 18.
- aa. Pectoral fin moderate, 2 to $2\frac{1}{2}$ times in length of head.
- b. *Rhodymenichthys*: Dorsal and anal joined to the caudal to the full height of the spines, without constriction at base of caudal; body greatly compressed, ribbon-like.
- c. Dorsal spines about 93; anal about 47; pectoral short, $2\frac{3}{8}$ in head, color red; no ocelli along base of dorsal *dolichogaster*, 19.
- cc. Dorsal spines 82; anal 11, 45; pectoral 3 in head. Color, grayish, a yellow streak from eye to axis *taczunowskii*, 20.
- bb. PHOLIS: Dorsal and anal slightly connected with caudal, leaving a constriction of outline at base of caudal; body less compressed; dorsal fin with dark blotches or ocelli.
- c. Pectoral well developed, about one-half length of head. Dorsal spines about 88; anal rays about 42; pectoral $2\frac{1}{8}$ in head; dorsal fin with dark quadrate blotches rather than ocelli; sides scarlet in adult, bounded with black *fasciatus*, 21.

18. PHOLIS PICTUS (Kner).

Trocentrus pictus KNER, Sitzungs- b. Denkschr. Akad. Wissensch., LVIII, 1868, p. 51, pl. VII, fig. 21; Singapore; an error, probably from Decastris Bay.

Centronotus pictus STEINDACHNER, Ichth. Beiträge, IX, 1880, p. 25.

Pholis pictus JORDAN and GILBERT, Rept. Fur Seal Invest., 1898, p. 383; Shana Bay, Iturup Island.—JORDAN and EVERMANN, Fish. N. and M. Am., III, p. 2415; Iturup.

Head $9\frac{1}{2}$ to $10\frac{1}{2}$; depth 8 to 10 D. XCIII or XCIV; A. II, 46 to 48. Eye as long as snout; mouth oblique, the upper jaw the longer, reaching to front of eye; pectoral very short, scarcely longer than eye, 3 to 4 in head; anal said to have an isolated channeled spine hidden in the skin, but our specimens show no peculiar structure. Color, yellowish, with 2 lengthwise series of large oblong blackish blotches, the one along base of dorsal, but not on the fin, of 21 or 22 blotches, the other on lower part of sides, of about 25; a series of fainter blotches along base of anal; in other specimens the lower row becomes obscure, the upper more distinct, and the series above anal disappears; a black bar downward from eye, a whitish band behind it; opercles dusky. Ochotsk Sea; our specimens from Shana Bay, Iturup Island, Kuril Group, not seen elsewhere in Japan.

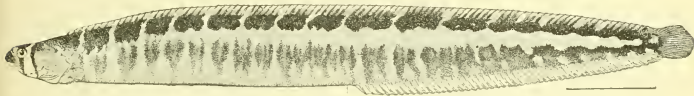


FIG. 15.—PHOLIS PICTUS.

As already shown by Steindachner, this is a typical *Pholis*, Kner having been in error in ascribing to it an isolated and channeled first anal spine. The ventral spines are bound down by the integument more closely than usual, but they are in other respects not peculiar. Each is accompanied by 2 short rays concealed in the membrane, and difficult to detect. The latter are stiff and pungent and seem not to be articulated. The ventrals of *P. ornatus* show the same structure. Kner gives the anal formula as II, 40. This must be a misprint for II, 49, as the artist figures 51 rays in the fin, not differentiating the 2 anterior ones.

(*pictus*, painted.)

19. PHOLIS DOLICHOGASTER (Pallas).

Blennius dolichogaster PALLAS, Zoogr. Rosso-Asiat., III, 1811, p. 175; Kamchatka. (Type in Mus. Berlin.)

Gunellus dolichogaster CUVIER and VALENCIENNES, Hist. Nat. Poiss., XI, 1836, p. 436.—BREVOORT, Exped. Japan, 1856, p. 270, pl. VII, fig. 2; Hakodate.

Centronotus dolichogaster GÜNTHER, Cat., 1861, p. 288.—STEINDACHNER, Sitzb. Ak. Wis. Wien, 1870, p. 22; Decastris Bay.

Muraenoides dolichogaster JORDAN and GILBERT, Synopsis, 1883, p. 768.

- Pholis dolichogaster* JORDAN and GILBERT, Rept. Fur Seal Invest., 1898, p. 383—
 JORDAN and EVERMANN, Fish. N. and M. Amer., III, p. 2416; Robben, Bering, and Medni islands, and Kigiktoiwik Bay.
- Gunnellus ruberrimus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIV, 1839, p. 440; Kuril Islands; after notes of PALLAS, Zoogr. Rosso-Asiat., III, 1811, p. 178.
- Muraenoides ruberrimus* BEAN in Nelson, Rept. Coll. Alaska, 1887, p. 305, pl. XIV, fig. 1.
- Rhodymenichthys ruberrimus* JORDAN and EVERMANN, Check-List Fishes, 1896, p. 474.
- Pholis ruberrimus* BEAN and BEAN, Proc. U. S. Nat. Mus., 1896, p. 248; Bering and Medni islands.—BEAN and BEAN, Proc. U. S. Nat. Mus., 1897, p. 389; Mororan.

Head $9\frac{4}{5}$ in length; depth 8; D. XCII; A. II, 44; P. 14; eye 5 in head; maxillary $2\frac{3}{4}$; pectoral $2\frac{1}{2}$; caudal 2; ventral spines $1\frac{3}{5}$ in eye. Body elongate, much compressed; head small, its upper profile convex; mouth moderate, very oblique, the maxillary reaching to below middle of eye; teeth rather large and blunt, arranged in a single row, the anterior one not enlarged; interorbital space narrow, without a sharp ridge, its width less than eye; snout equal in length to eye; distance from tip of snout to occiput $1\frac{5}{8}$ in head; head entirely naked; body covered with small, cycloid, inconspicuous scales; origin of dorsal over upper end of gill-slit, its distance from nape equal to distance from nape to front of eye, the spines toward the anterior end of fin the highest; origin of anal a little nearer tip of caudal than snout; dorsal and anal confluent with caudal, the anal more broadly connected than dorsal; pectoral small, rounded behind; ventral spines inserted directly under base of pectorals, their length little greater than their distance apart; caudal short and broad, well rounded in outline.

Bering Sea; recorded from the Kuriles and from Robben, Medni, and Bering islands, and from Kigiktoiwik Bay; not taken by us in Japan. The specimen above described was taken at Robben Island by Capt. J. G. Blair, then in command of the guard-ship *Leon*. It is 9 inches long and is uniform red in color, with a few pale dots. Another specimen, 18 cm. long, taken by Mr. Gerald E. H. Barrett-Hamilton at Bering Island, shows the following characters: The color is cherry red on the body and fins, lighter on belly, lower half of cheek and under side of head; lips blackish anteriorly, a narrow black streak running from them along snout to eye and from eye across cheek and opercles toward upper edge of pectoral base; this line separates the deep red upper part of the head from the lighter area below; sides of body with a number of minute scattered black spots; along middle of side is a distant series of light spots as large as the pupil, the margin of each with 2 to 4 black specks like those scattered over sides. The dorsal and anal more widely joined to the caudal than in other species, the fins being higher posteriorly and without perceptible notch. The

dorsal contains 93 spines, the anal 2 spines and 47 rays, the pectorals 15 rays. Head $9\frac{1}{2}$ in length; depth $7\frac{5}{8}$; eye 5 in head; maxillary $3\frac{3}{4}$; pectorals $2\frac{1}{2}$; caudal $2\frac{1}{2}$; ventral spine $2\frac{1}{8}$ in eye.

(*δολιχός*, long; *γαστήρ*, belly.)

20. *PHOLIS TACZANOWSKII* (Steindachner).

Centronotus taczanowskii STEINDACHNER, Ichth. Breit., IX, 1880, p. 24, pl. III, fig. 1; Gulf of Strielok, Okhotsk Sea. (Coll. Professor Dybowski.)

Pholis taczanowskii JORDAN and EVERMANN, Fish N. and M. Amer., III, p. 2416; copied.

Head $8\frac{3}{8}$ in length; depth $7\frac{3}{8}$; depth of caudal peduncle $5\frac{1}{4}$ in head; eye $4\frac{1}{4}$; snout $4\frac{3}{8}$; interorbital space 7; D. LXXXII; A. II, 45.

Head small; interorbital space narrow, arched; jaws about equal; mouth oblique; teeth in narrow bands on anterior parts of jaws, short, heavy, the tips bluntly rounded; 3 or 4 small teeth on vomer; gill-rakers 3 + 7, short, slender, pointed; head naked, no filaments; no lateral line; scales of body minute, cycloid, deeply embedded; no scales on membrane of dorsal or anal. Dorsal inserted above base of pectorals, composed of strong, curved spines, the longest or posterior ones contained about $4\frac{1}{2}$ times in head; membrane of fin thick, not incised between the spines; anal inserted below thirty-seventh dorsal spine, the spines similar in shape and size to those of the dorsal directly above; the rays somewhat shorter than the spines of the dorsal, the membrane thick, not incised between the rays; caudal rounded, 2 in head; pectoral rounded, $2\frac{1}{2}$ in head; ventrals minute, the spines strong.

Color in alcohol brownish-yellow, a mere trace of a dark line passing backward from tip of snout through eye, the head light in color below the line.

This description is of specimens about 120 mm. long. Smaller specimens, about half that length, always have the ocular line very distinct, sharply dividing the upper, somewhat dusky coloring of the head from the lower, much lighter part. Many small individuals are strikingly mottled with dusky, there usually being a series of small vertical bars on the dorsal and anal and a row of round light spots along the sides. All degrees of coloration from the extensively mottled to the plainly colored may be found among the young, the ocular line always being present. This species is extremely abundant at Hakodate, living in the kelp and among the rocks along the shore.

(Named for Professor Taczanowsky.)

21. *PHOLIS FASCIATUS* (Bloch and Schneider).

Centronotus fasciatus BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 165, pl. XXXVII, fig. 1; Tranquebar (an error).—GÜNTHER, Cat., III, 1861, p. 287.

Gunnellus grenlandicus CUVIER and VALENCIENNES, Hist. Nat. Poiss., XI, 1836, p. 442, Greenland; after Bloch and Schneider.—REINHARDT, Dansk. Vidensk. Selsk. Nat. og Mathem. Afh., VII, 1838, p. 122.

- Gunnellus muranoides* VALENCIENNES in Cuvier, Règne Animal, Poiss., p. 916; pl. LXXVIII, fig. 2; after Bloch and Schneider.
- Blennius tania* PALLAS, Zoogr. Rosso-Asiat., III, 1811, p. 178; Kuril Islands.
- Pholis tania* BEAN and BEAN, Proc. U. S. Nat. Mus., 1897, p. 308; Petropaulsky.
- Muranoides maxillaris* BEAN, Proc. U. S. Nat. Mus., 1881, p. 147; St. Paul Island, Alaska. (Type, No. 23999. Coll. Henry W. Elliott.)—JORDAN and GILBERT, Synopsis, 1883, p. 768.
- Gunnellus fasciatus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., XI, 1836, p. 441.
- Muranoides fasciatus* JORDAN and GILBERT, Synopsis, 1883, p. 767.
- Muranoides tania* JORDAN and GILBERT, Synopsis, 1883, p. 766.
- Pholis fasciatus* GILBERT, Rept. Fish Comm., 1893, p. 449.—JORDAN and GILBERT, Rept. Fur Seal Invest., 1898, p. 480.

Head 8 to $9\frac{1}{2}$; depth 7 to 9; D. LXXXIV to LXXXIX; A. II, 42 to 44; V. I, 1.

Head scaleless; mouth decidedly oblique, the tip of lower jaw on a level with middle of eye; teeth short, blunt, in narrow bands on jaws; 3 or 4 teeth on the vomer; eye equal to snout, a little more than interorbital width; ventral spine $\frac{2}{3}$ eye, $\frac{1}{2}$ length of mandible; caudal $\frac{1}{2}$ head; pectoral $2\frac{1}{4}$ in head; vertical fins slightly joined at base.

Ground color, yellowish-gray in life, the sides of a brilliant scarlet; base of dorsal occupied by 10 or 11 oblong blotches of dark brown, which extend to the tips of the fins; these blotches each divided on the fin by a median spot of the ground-color, the areas of the ground-color alternating with these blotches finely speckled with brown, a large spot of brown usually occupying a median position upon the fin; middle and lower part of side occupied by vermiculating brown lines on the ground-color, these vermiculations arranged in more or less distinct cross-bars, about 20 in number, reaching to or nearly to the midventral line, the posterior ones often continue on to the anal fin; pectoral and caudal fins yellow, unmarked; a brown blotch across snout and tip of mandible, followed by a narrow yellowish bar descending to front of eye; interorbital space crossed by a broad brown bar with blackish margins, which become much narrower below and traverse the eye and the cheek; behind this a broader yellow bar margined behind with a narrow brown line.

In life, the coloration is extremely brilliant, the pale markings being bright orange or scarlet.

Bering Sea and Arctic Ocean, from Greenland to the Kurils, locally abundant; numerous fine, large specimens taken from the stomachs of cormorants on St. Paul Island, Pribilof group; others dredged in shallow waters. Two specimens, each about 90 mm. long, were taken at Aomori. We have still others from Bristol Bay and Upernavik, Greenland. In the museum at Hakodate is a specimen of some other species of *Pholis*, from Nemuro, with 105 dorsal spines and 25 dark crossbands.

(*fasciatus*, banded.)

12. GUNNELLOPS Bleeker.

Gunnellops BLEEKER, Versl. Ak. Amst., (2), VIII, 1874, p. 368 (*roseus*).

This genus is apparently distinguished from *Pholis* by the tapering tail, around which the vertical fins are confluent; palatine teeth present.

(*gunnellus*, gunnel, gunwale, an old name of the European *Pholis gunnellus*; ὠψ, appearance.)

22. GUNNELLOPS ROSEA (Pallas).

Blennius roseus PALLAS, Zoogr. Rosso-Asiat., III, 1811, p. 177, Kuril Islands.

Centronotus roseus GUNTHER, Cat., III, 1861, p. 290.

Gunnellops roseus JORDAN and EVERMANN, Check-List Fishes N. and M. Am., 1896, p. 474; Fishes N. and M. Am., III, p. 2420.

D. 100; A. 90; P. 9; V. I. Head obtuse, the lower jaw projecting; eyes large; body very long, compressed, tapering into a slender tail; pectoral small, ovate, hyaline; 2 spines in place of ventrals; dorsal extending from the nape to the end of the tail; anal joined to caudal. Color intensely red. Kuril Islands. (Pallas.) Not seen by any recent collector.

(*roseus*, rosy.)

13. ALECTRIAS Jordan and Evermann.

Alectrias JORDAN and EVERMANN, Fishes N. and M. Am., III, p. 2869 (*electrolophus*).

Body elongated, compressed, covered with very small, embedded scales which are obsolete or concealed anteriorly; lateral line obsolete. Head small, compressed, with fleshy crest above; eyes small; mouth oblique; teeth in each jaw in a narrow band, the outer somewhat enlarged; narrow bands of teeth on vomer and palatines; gill-membranes narrowly attached to the isthmus; sometimes with a free fold behind; branchiostegals 5. Dorsal fin not very low; anal spine; ventrals wanting; caudal fin small, entire; pectoral fins moderate or small; pyloric caeca present, few. Pacific Ocean; differing from the more southern genus *Anoplarchus* in having the gill-membranes narrowly joined to the isthmus, leaving a free fold behind.

(ἀλέκτωρ, a cock, from the crested head.)

23. ALECTRIAS BENJAMINI Jordan and Snyder, new species.

Head $5\frac{1}{2}$ in length; depth $5\frac{1}{3}$; depth of caudal peduncle 4 in head; eye 5; interorbital space $9\frac{1}{2}$; snout 4; D. LV; A. I, 41.

Depth equal to length of head measured to edge of opercle; head large; mouth oblique; the maxillary extending to a vertical passing through posterior edge of orbit; jaws equal; eyes directed somewhat obliquely; interorbital area arched; teeth small, sharp, in narrow bands on jaws, the outer ones enlarged; vomer and palatines with narrow bands of minute teeth; gill-membranes narrowly attached to the isthmus, united forming a fold across it; gillrakers on first arch about

12. represented by mere elevations; pseudobranchiae large; head with a conspicuous crest, extending along median line from tip of snout to nape, highest on occiput, its greatest elevation somewhat less than diameter of orbit.

Head naked, without filaments; scales on body posterior to region of anal opening minute, smooth, deeply imbedded; no scales on membranes of fins; no lateral line.

Dorsal inserted above base of pectorals, connected with the caudal posteriorly, no incision separating them; membrane of fin thick, fleshy, concealing the spines, not incised between their tips; spines strong, curved, pungent, those near middle of posterior half of fin longest, $3\frac{3}{5}$ in head; anal inserted below base of fifteenth or sixteenth spine of dorsal; the spine minute, concealed; membrane of fin fleshy, concealing the rays, not incised on its edge, connected with the caudal, the longest rays equal to length of snout; caudal rounded, 2 in head; pectoral rounded, $2\frac{1}{2}$ in head; no ventrals.

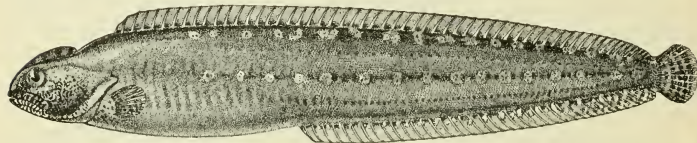


FIG. 16.—*ALECTRIAS BENJAMINI*.

Color in spirits yellowish-olive, darker above than below; a row of whitish spots, larger than orbit, on body along back of dorsal, the spaces between the spots darker than other parts of the body, the spots themselves speckled with black; a similar row of spots along middle of side; an indistinct dark line extending backward and downward from eye; cheeks, chin, and throat speckled and finely mottled with blackish; crest with 4 dark vertical bars; anal with whitish spots bordered with blackish; caudal with indistinctly outlined vertical light and dark bars; pectoral light, with a few dusky lines.

Described from a specimen 95 mm. long. Considerable variation in color is shown, some being very dark and almost entirely unmarked, some dark, with the lighter marking showing conspicuously, others light, with an indistinct lateral band more or less broken; in all, the marking on the chin and throat persists more or less plainly. The length of the maxillary is slightly shorter in some individuals than in others, occasionally not extending much beyond the pupil.

Dorsal spines.	Anal rays.
57	38
58	42
55	41
58	40

The species differs from *A. alectrolophus* in having a longer head, deeper body, fewer dorsal spines, fewer anal rays, a longer maxillary, and in having the chin and throat peculiarly marked. We have secured many specimens from Hakodate.

Type, No. 7074, Leland Stanford Junior University Mus. Cotype, No. 50295, U.S.N.M.

(Named for Dr. Marcus Benjamin, editor of the Proceedings of the United States National Museum.)

14. EULOPHIAS Smith.

Eulophias H. M. SMITH, Bull. U. S. Fish Comm., 1901 (March 28, 1902), p. 93 (*tanneri*).

Body very elongate; dorsal fin low, extending entire length of body and consisting of numerous rigid spines succeeded by a few simple rays; anal fin long and low, composed of one spine and numerous simple soft rays; caudal fin small but distinct, blended with the dorsal and anal; pectoral fins short and pointed; ventral fins absent; scales absent; no lateral line; gill-membranes broadly united, free from the isthmus; nostrils tubular; ventral opening in advance of middle of body.

(*εὐ*, well; *λοφία*, one having a bristly back, in allusion to the very long spinous dorsal fin.)

24. EULOPHIAS TANNERI H. M. Smith.

Eulophias tanneri H. M. SMITH, Bull. U. S. Fish Comm., 1901 (March 28, 1902), p. 94, Suruga Bay, Japan, at U. S. Fish Commission steamer *Albatross* Sta. 3715, in about 67 fathoms, May 11, 1900.

Type.—No. 49798, U.S.N.M.

Body elongate, eel-like, cylindrical anteriorly, compressed posteriorly; tapering gently backward and terminating in a blunt point; greatest depth about 0.05 total body length; head rather long, conical, not larger than body, its length 0.12 body length, terminating posteriorly in a rounded flap; eye large, directed slightly upward, rather less than 0.33 length of head; interorbital space contracted, not wider than pupil; snout short, rounded, 0.5 length of eye; mouth rather large, terminal slightly oblique, jaws equal, maxillary extending to vertical of anterior edge of pupil; nostrils tubular, midway from eye to end of snout; gill membranes broadly united, not attached to isthmus; anal orifice 0.4 distance from snout to end of body; dorsal fin low, continuous, beginning slightly in advance of posterior edge of opercle and extending to caudal fin, gradually increasing in height from before backward; composed of 121 stiff spines and 13 simple soft rays; anal fin long and low, beginning under thirty-sixth dorsal spine and extending to caudal; consists of 1 spine and about 75 simple rays, the length of the spine being about twice that of the adjoining rays; caudal fin

blended with dorsal and anal, composed of 7 simple rays; pectoral fins short, pointed, and narrow, less than half length of head. Length of specimen, 45 mm.

Underparts whitish; a series of brownish elongated blotches about 20 in number, extending along side from head to tail; above these a series of smaller blotches of same color, about twice as numerous; a dark-brown stripe, less than width of eye, extending behind eye; a blackish blotch on cheek beneath eye, extending anteriorly and posteriorly on the branchiostegal membrane; gill membrane with dark-brown area; fins unmarked.



FIG. 17.—EULOPHIAS TANNERI.

“This interesting species is named for Commander Z. L. Tanner, U. S. N., commander of the United States Fish Commission steamers *Albatross* and *Fish Hawk* from 1879 to 1894, the foremost exponent of the methods of modern deep-sea exploration, whose intelligent and zealous investigations have led to most valuable contributions to oceanic biology and physics.” (Smith.)

15. NEOZOARCES Steindachner.

Neozoarces STEINDACHNER, Ich. Beitr., IX, 1880, p. 26 (*pulcher*).

Body elongate, compressed, pointed behind the dorsal and anal, united around the tail; dorsal rays very numerous, low, the spinous part lower and longer than the soft part, the spines stiff, slender, and sharp; pectoral well developed; no ventrals; mouth very long, with numerous blunt, conical teeth in several rows in the jaws; similar teeth on the vomer and palatines; a tentacle on the snout; gill-openings wide, the gill-membranes joined, free from the isthmus; scales small, imbedded; no lateral line.

Japan; curious little fishes, brightly colored; not closely allied to any of the other blennies.

(*νερός*, new; *Zoarces*, a genus of another family.)

- a. Head $4\frac{3}{5}$ in length; maxillary extending far beyond eye; head below with a distinct dark network *pulcher*, 25.
 aa. Head $6\frac{1}{2}$ in length; maxillary extending little beyond eye; head relatively plain below *steindachneri*, 26.

25. NEOZOARCES PULCHER Steindachner.

Neozoarces pulcher STEINDACHNER, Ichth. Beitr., IX, 1880, p. 27, pl. VI, fig. 2; Gulf of Strielok.

Head $4\frac{2}{5}$ in length; depth $9\frac{1}{3}$; eye $6\frac{1}{3}$; snout $4\frac{1}{3}$; D. XLI+50; A. I.+75; P. 10.

Head deep and long, much larger than in *N. steindachneri*; mouth

very large, the cleft and the maxillary excessively large, extending far beyond eye; teeth on jaws, vomer, and palatines; snout with a prominent, unbranched villus anterior to the interorbital space; head naked; body with minute scales, no lateral line. Dorsal and anal confluent with the small, pointed caudal.

Color, much like that of *N. steindachneri*, except that the head below eye is covered with a distinct, dusky network; the belly is similar, the lines being somewhat less distinct; a median row of small, dusky spots extends along the side, larger anteriorly, becoming smaller and disappearing as the caudal is approached.

The species has not been seen by us. It is probable that the description of Steindachner covers two distinct species, the one figured having a larger head, a much wider mouth and longer maxillary, and differing in color from the other, which is our *Neozoarces steindachneri* (*pulcher*, pretty).

26. NEOZOARCES STEINDACHNERI Jordan and Snyder, new species.

Head $6\frac{1}{3}$ in length; depth 9; eye 5 in head; snout 5; interorbital space $7\frac{1}{2}$; D., XXXVIII, 49; A. I, 72.

Head long, pointed; the jaws equal; interorbital space flat or slightly concave; maxillary extending beyond eye, equal in length to

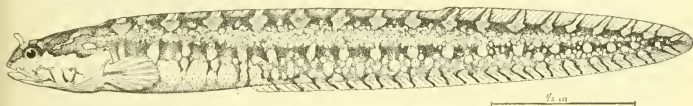


FIG. 18.—NEOZOARCES STEINDACHNERI.

one-half the distance between tip of snout and posterior edge of opercle exclusive of flap. Teeth in narrow bands on jaws, vomer, and palatines. Pseudobranchiae large; gillrakers on first arch $4+12$, rather thick, pointed. Anterior part of interorbital space with a rather thick, erect tentacle, about equal in height to diameter of pupil; a low fleshy keel on snout anterior to the tentacle; no other tentacles on head. Nostrils with slender tubes; head naked; body covered with minute circular deeply embedded scales; no lateral line. Dorsal inserted above base of pectoral, confluent with the caudal; spines short, strong, curved, the longest not equal in height to diameter of eye; length of spinous part $2\frac{1}{10}$ in head and body; rays of dorsal higher than the spines; membrane of fin fleshy, especially anteriorly, concealing the spines and rays, not incised on the border; anal about equal in height to the spinous dorsal, the spine strong; membrane of fin fleshy, becoming more thin posteriorly, not incised between the rays; fin confluent with the caudal; caudal a little shorter than diameter of eye, pointed; confluent above and below with dorsal and anal; pectoral $1\frac{3}{4}$ in head, rounded, the edge incised between the rays.

Color in spirits, yellowish-white, mottled and reticulated with dusky; a series of about 17 dark, vertical bars on upper fourth of body extending to top of fin, the bars shaped somewhat like an hourglass, the lateral borders black, the upper inside parts growing lighter posteriorly, the borders appearing as black lines; middle of body with a row of quadrangular spots with narrow bands extending downward from the corners along sides of belly; posterior to anal opening the bars are replaced by a network from which blackish lines pass down over the anal; between the dark lateral spots, at regular intervals, are circular spaces of the body color; between the dorsal and the median spots is an indistinctly mottled area; snout, interorbital space, and occiput, each with a broad, transverse, dusky band; a white area with wavy borders extending from tip of snout to end of opercular flap; lower part of head with a network of lines inclosing 3 or 4 spaces; throat white; chin with 2 narrow cross-bars; pectoral with a narrow dusky bar extending outward from the base to near middle of fin. One specimen is darker than the others, the color-pattern being the same.

Five specimens, 60 mm. long, from Hakodate and one from Otaru. Found living among the algae in shallow water.

Type No. 7075, L. S. Jr. Univ. Mus.; cotype No. 50277, U. S. N. M.

The species differs from *N. pulcher* as figured and described by Steindachner in having a longer and more pointed head, a shorter mouth, and in color.

(Named for Dr. Franz Steindachner.)

16. ZOARCHIAS Jordan and Snyder.

Zoarchias JORDAN and SNYDER new genus, of *Bleenniidae* (*veneficus*).

This genus differs from *Nozources* in the much shorter spinous dorsal and the much greater number of rays in the soft dorsal. There is no tentacle on the forehead.

Northern Japan.

(Name modified from *Zoarchus*, a more correct form of *Zoarces*.)

27. ZOARCHIAS VENEFICUS Jordan and Snyder, new species.

KAZUNAGI (SWARMING EEL).

Head $6\frac{3}{4}$ in length; depth 11; eye 5 in head; snout $3\frac{1}{2}$; interorbital space $7\frac{1}{2}$; D. XXVIII, 77; A. I, 78.

Body long and slender, gradually sloping from head to the pointed tail. Head long, pointed; snout sharp; the jaws equal; eyes high up, the upper rim of orbit forming a fleshy projection above level of interorbital space. Mouth wide, the cleft on lower side of head, parallel with ventral outline, the maxillary extending beyond orbit, its length equal to one-half the head; teeth in narrow bands on jaws, vomer, and

palatines; gill-membranes forming broad fold across isthmus; gill-rakers on first arch about 3+12, minute, slender, pointed; pseudo-branchiae large; head without filaments or papillae; nostrils with tubes; head naked; body with minute, circular, deeply-embedded scales; no lateral line.

Dorsal inserted above base of pectoral, the spines strong, curved, pungent, their length somewhat less than diameter of orbit; membrane of fin thick anteriorly, becoming somewhat thinner posteriorly, concealing the spines and rays not incised between them; anal inserted below eighteenth spine of dorsal, the spine strong, equal in height to the rays, which are somewhat less than diameter of orbit; membrane of fin not incised; dorsal and anal confluent with the caudal, which is sharply rounded; pectoral rounded, $1\frac{1}{2}$ head; no ventrals.

Color in spirits, light brownish-yellow, marked with dusky; head clouded and reticulated above, almost immaculate below, the lower border of the dusky color sharply defined by a band from snout through lower part of eye to opercle; dusky color of body forming a sort of network with a row of circular openings about the size of



FIG. 19.—ZOARCHIAS VENEFICUS.

pupil, extending along middle of side to tail; above the larger openings are many smaller ones; prolongations extend upward and downward from the network, forming pointed vertical bars on the fins, 21 on the dorsal, 18 on the anal; sides of belly with 4 or 5 pointed projections; pectoral with a small dark spot at its base.

A great many specimens measuring about 70 mm., were collected at Hakodate. They were scooped up by the native children in large baskets from the algae growing in the shallow water near shore. Specimens were also found at Mororan and at Otaru.

Type No. 7076, L. S. Jr. Univ. Mus.; cotype No. 50278, U.S.N.M. (*veneficus*, one who bewitches, from the bewildering coloration.)

17. DICTYOSOMA Schlegel.

Dictyosoma SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 139 (*burgeri*).

Body elongate, covered with very small, smooth scales; lateral line forming an elaborate network; two series of mucous pores running longitudinally, connected by vertical cross lines. Mouth moderate, the jaws with small teeth; no teeth on vomer or palatines; dorsal fin long, of many spines and a few soft rays, the soft part partly joined to

the caudal; anal with two simple spines; ventrals reduced each to a scale-like projection, which disappears in maturity.

Japan.

(*δίκτυον*, net; *σῶμα*, body.)

28. *DICTYOSOMA BURGERI* Van der Hoeven.

DAINANGINPO (FORMOSA SILVER-TAIL). KAMISORI UWO (RAZOR-FISH).

Dictyosoma SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 139, pl. LXXIII, fig. 3, Shimabara, near Nagasaki.

Dictyosoma burgeri VAN DER HOEVEN, Handbuch der Dierkunde, about 1850, p. 347.—BLEEKER, Ichth. Fauna Japan, 1853, p. 9; Kaminoseki.

Dictyosoma temminckii BLEEKER, Verh. Bat. Gen., XXV, Japan, p. 42; Nagasaki.—GÜNTHER, Cat. Fish., III, 1861, p. 279, copied.—ISHIKAWA, Prel. Cat., 1897, p. 35; Boshu, Misaki, Sagami Bay, Hakodate, Kishin.

Head $6\frac{1}{2}$ in length; depth $7\frac{1}{2}$; eye $6\frac{1}{2}$ in head; interorbital space 13; snout $4\frac{1}{3}$; D. LII, 10; A. I, 42.

Snout short, blunt, the upper part with a fleshy ridge, which continues backward to the occiput, growing lower posterior to eyes; lower jaw somewhat longer than the upper; mouth oblique, maxillary extending slightly beyond a vertical through posterior edge of orbit; lips very large, thin; teeth in narrow bands on jaws, vomer, and palatines, the outer row on the jaws enlarged; gill-rakers on first arch 2 + 10, small, slender, rather widely spaced; pseudobranchiæ large; nostrils with small tubes; no filaments on head.

Head naked; body covered with minute, rather deeply embedded scales; lateral line forming a complicated network on body.

Dorsal inserted a little posterior to base of pectoral, spines growing longer posteriorly, the longest $3\frac{1}{4}$ in head; longest rays $2\frac{2}{3}$; membrane of fin thick and fleshy, concealing the spines, not incised; anal spine weak, rays becoming longer posteriorly, those near middle of fin measuring $3\frac{3}{8}$ in head; membrane of fin thickened about the rays, incised between them, leaving the tips free; dorsal and anal united with the caudal, there being a small incision at their union; pectoral rounded, $2\frac{1}{2}$ in head; ventrals sometimes represented, usually in small specimens, sometimes in large ones, by a pair of minute spines.

Color, blackish or bluish olive, the head lighter, finely speckled with blackish; a broad light band passing downward and backward from eye. Some individuals have the body sparsely spotted with black.

This species is very abundant in the rocky bays of middle Japan. Our many specimens are from Aomori, Tokyo, Misaki, and Wakanoura. It reaches a length of about 15 inches, and often comes into the markets.

(Named for Mr. Bürger, who collected specimens and drawings at Nagasaki for Siebold and Schlegel.)

18. OPISTHOCENTRUS Kner.

Opisthocentrus KNER, Sitzber. Akad. Wiss. Wien, 1868, p. 49 (*quinquemaculatus*).
Bleenniophidium BOULENGER, Proc. Zool. Soc. Lond., 1892, p. 583 (*petropauli*).

Body moderately elongate, compressed, covered with very small cycloid scales; head with small scales; mouth small, protractile, with fleshy lips; small conical teeth on jaws and on vomer; no cirri; gill-membranes broadly connected, but free from isthmus; branchiostegals 4; dorsal fin very long, extending from the nape to the caudal, with which it is subcontinuous, a few of the posterior rays stiff spines, the rest being simple, not articulate, flexible; anal fin extending from the anus, which is a little nearer the anterior than the posterior extremity, to the caudal, with two slender spines in advance of the soft rays; no ventrals; no lateral line; no prominent anal papillæ; pyloric appendages present. A remarkable genus, allied to *Lumpenus*, or rather to *Plectobranchnus*, distinguished by having only the posterior spines rigid.

North Pacific.

(ὄπισθε, behind; κέντρον, spine.)

- a. Dorsal rays about 59; anal II, 36; no sharply defined cross-streaks on head; dorsal fin with about 6 black ocelli *ocellatus*, 29.
- aa. Dorsal rays about 51; anal II, 33; head with sharply defined cross-lines like pen marks; dorsal fin with about 4 blackish spots *zonope*, 30.

29. OPISTHOCENTRUS OCELLATUS (Tilesius).

GAZU.

Ophidium ocellatum TILESIIUS, Mem. Ak. St. Petersburg, II, 1811, p. 237; Kamchatka, D. 80; A. 50 (evidently an error). The rude figure shows D. 73; A. 50; the spines low; the dorsal with 5 ocelli.

Gunnellus apos CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIV, 1839, p. 426, after Tilesius.

Centronotus apos GÜNTHER, Cat., III, 1861, p. 288.

Centronotus (Opisthocentrus) quinquemaculatus KNER, Sitzber. Akad. Wiss. Wien, 1868, p. 48, pl. VII, fig. 20; "Pinang." Described from a young example 2 inches long, No. 6353, Mus. Wien. Doubtless from Decastris Bay.

Opisthocentrus reticulatus STEINDACHNER, Ichth. Beitr., X, 1881, p. 11, pl. v, fig. 2; Gulf of Strielok (Coll. Prof. Dybowski).

Bleenniophidium petropauli BOULENGER, Proc. Zool. Soc. Lond., 1892, p. 584, with plate; Petropaulski (Coll. George Baden-Powell). D. 52; A. 37; 5 ocelli.

Opisthocentrus tenuis BEAN and BEAN, Proc. U. S. Nat. Mus., 1897 (January 28), p. 463, pl. XXXV; Volcano Bay, Port Mororan, Japan. (Coll. Col. Nicolai A. Grebnitski. Type No. 47565, U.S.N.M.)

Opisthocentrus quinquemaculatus STEINDACHNER, Ichth. Beitr., IX, 1880, p. 25.—BEAN and BEAN, Proc. U. S. Nat. Mus., 1896, pp. 381, 392; Petropaulski.

Opisthocentrus ocellatus JORDAN and GILBERT, Rept. Fur Seal Invest., 1898, p. 384.—JORDAN and EVERMANN, Fish N. and M. Amer., III, p. 2429.

Head $5\frac{2}{3}$ in length; depth 6; depth of caudal peduncle $2\frac{4}{5}$ in head; eye $4\frac{2}{3}$; interorbital space $5\frac{2}{3}$; snout 6; D. LIX; A. II, 36.

Interorbital space low, flat; snout sharp; jaws equal; mouth oblique,

maxillary as long as snout, not reaching anterior edge of orbit, teeth in narrow bands on jaws; about 4 small teeth on the vomer, none on the palatines. gillrakers on first arch 3+12, the upper 3 very small, the lower series rather long and slender, except the lowermost 2 or 3, which are short; pseudobranchiæ large, nostrils with small tubes; no tentacles on head. Membrane of dorsal somewhat thickened, not incised between the spines; anterior rays rather soft, the posterior ones strong, curved, pungent; height of middle rays $3\frac{1}{2}$ in head; membrane thickened, especially anteriorly incised between the rays. Caudal rounded, $1\frac{1}{3}$ in head; pectoral similar in shape, $1\frac{2}{3}$ in head.

Head with scales, except on snout and ventral parts; body covered with minute scales; membrane of dorsal with scales between the rays, especially on posterior part; no lateral line.

Body olivaceous, vaguely mottled or reticulated with dusky; upper part of head dark; a dark line extending downward from eye; dorsal fin with 6 prominent ocelli, which grow longer and less sharply defined with age, the young often bright green, taking the color of the eel grass in which they live. The species is subject to much variation.

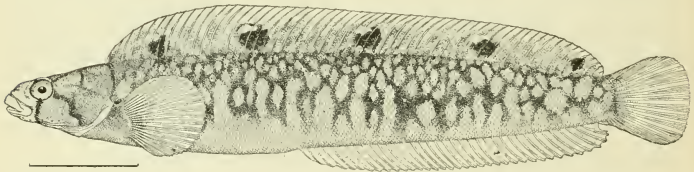


FIG. 20.—*OPISTHOCENTRUS OCELLATUS*.

The head measures from $4\frac{1}{2}$ to 6 in the length according to age. The spots in our specimens vary from 5 to 7. The dusky mottling may be absent from the body, or it may be very conspicuous, there being all gradations of color from one locality. Jordan and Evermann note the following variations: Ocelli 5 to 9, usually 6; dorsal 55 to 61, usually 58 or 59; anal 36 to 39 (including the spines which are counted as rays).

Some specimens from Petropaulski Harbor (representing *O. reticulatus* Steindachner) have markings on the head and neck much like our *O. zonope*. They have, however, vomerine teeth and a larger number of dorsal ocelli and also more dorsal spines, agreeing in those respects with *O. ocellatus*.

Our very many specimens are from Hakodate, Aomori, Mororan, and Otaru. We have examined others from Petropaulski. The species is excessively common in the Bay of Mororan, the young swarming in the eel-grass, *Zostera*.

(*ocellatus*, with eye-like spots.)

30. *OPISTHOCENTRUS ZONOPE* Jordan and Snyder, new species.

Head $5\frac{1}{2}$ in length; depth $5\frac{1}{4}$; depth of caudal peduncle $2\frac{2}{3}$ in head; eye $4\frac{1}{2}$; snout $3\frac{1}{2}$; interorbital space $4\frac{3}{4}$; D. LI; A. II, 33.

Body a little deeper than in *O. ocellatus*; interorbital space broad and flat; jaws equal; maxillary short, scarcely reaching anterior edge of pupil; teeth small, blunt, widely spaced, in narrow bands on jaws, none on vomer or palatines; gill-rakers on first arch 13, small, slender, pointed; pseudobranchiae large; nostrils with tubes; no filaments on head; large mucous tubes on head; a row on lower jaw, on posterior and anterior borders of eye, and another extending from eye to upper edge of gill-opening; a large pore between eyes and also on nape. Head with scales on cheeks and occiput; body with small, smooth scales; membrane of dorsal fin with a few minute scales extending upward on its base, more evident on posterior part; no lateral line.

Dorsal inserted above base of pectoral, joined to the caudal posteriorly, a notch separating them; membrane of fin thickened anteriorly, not incised along its edge; spines slender except the last 12 or 15,

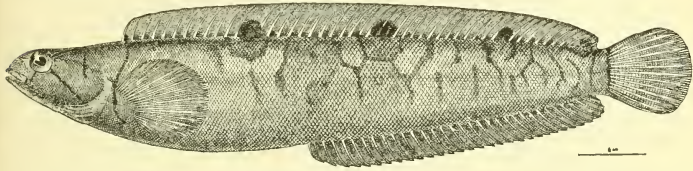


FIG. 21.—*OPISTHOCENTRUS ZONOPE*.

which are strong, stiff, and curved, those near middle of fin contained two times in head; anal inserted below nineteenth spine of dorsal, the spines slender, weak, and not pungent, the rays near the middle contained about $2\frac{2}{3}$ in head; the fin not connected with the caudal; the membrane rather thin, incised between the rays; caudal rounded, $1\frac{1}{4}$ in head; pectoral broad, rounded, $1\frac{1}{4}$ in head, no ventrals.

Color, light olive-green, the sides with indistinct, irregularly shaped, vertical lines or bars, in some specimens connected in a network; head with a number of sharply defined, narrow, dark bands, one passing across interorbital space through eye, downward on chin, another extending from eye backward and downward to subopercle, a curved band passing over occiput and connecting eyes, another passing over the nape and downward on opercle; a narrow band extending from base of pectoral upward to beginning of dorsal (these lines present and sharply defined on a series of 25 specimens); base of caudal with a narrow, vertical, dark band; dorsal with 4 large, round, black spots with faint, light margins, the first spot on the twelfth and thirteenth spines, the second on the twenty-fifth and twenty-sixth, the fourth

near end of fin; the second spot as large as eye; the number and location of the spots are constant in our specimens; the dorsal fin is also lightly clouded with dusky.

Described from a specimen about 125 mm. long. Type 7077, L. S. Jr. Univ. Mus.; co-type No. 50292, U.S.N.M. The species may be recognized at a glance by the bands on the head and the 4 large spots on the dorsal. It is represented by many specimens from Mororan, and one from Otaru. It occurs in shallow water in the eel-grass.

Dorsal spines.	Anal rays.
52	II, 30
51	II, 31
52	II, 33
50	II, 29
51	II, 33
52	II, 31
51	II, 33

(ζώνη, zone; όπή, look.)

19. ABRYOIS Jordan and Snyder, new genus.

Abryois JORDAN and SNYDER, new genus of *Blenniidae* (*azumæ*).

This genus differs from *Opisthocentrus* in having a naked head without tentacles; teeth in narrow bands on jaws and vomer, none on palatines; gill membranes forming a broad fold across the isthmus; body with minute, partly embedded scales; membranes of dorsal and anal with scales; dorsal spines flexible anteriorly, becoming strong near the middle, the posterior ones rather heavy; anal with 2 slender spines.

(*α*, neg. prefix; βρῦόεις, mossy, there being no tentacles on the head.)

31. ABRYOIS AZUMÆ Jordan and Snyder, new species.

Head $6\frac{2}{3}$ in length; depth 6; depth of caudal peduncle $1\frac{1}{2}$ in head; eye $6\frac{1}{2}$; interorbital space $4\frac{3}{4}$; snout $3\frac{1}{2}$; D. LII; A. II, 40.

Interorbital space broad, convex; snout rather blunt; jaws equal; mouth oblique, maxillary extending to a vertical through anterior edge of pupil; teeth stout, sharp, in narrow bands on jaws and vomer, none on palatines. Anterior edge of shoulder girdle with an elevated sharp ridge. Gill-rakers on first arch 4+14, close set, the middle ones long, slender. Nostrils with tubes; no tentacles on head. Numerous large mucous pores on head. Head naked; body covered with small, close set, partly embedded, cycloid scales; membranes of dorsal and anal with scales between the spines and rays; basal fourth of caudal with scales; no lateral line.

Dorsal inserted above base of pectoral, the spines gradually growing higher to a point above middle of anal, where they measure 3 in the

head; anterior spines slender, soft, growing stiff and pungent near middle of fins; posterior spines strong, curved, the basal half compressed; membrane of fin fleshy, not incised between the spines. Spines of anal small, the tips pungent, rays highest near anterior end of fin, $2\frac{2}{5}$ in head; membrane thick, slightly incised between the rays. Caudal rounded, $1\frac{1}{2}$ in head. Pectoral rounded $1\frac{1}{2}$ in head.

Color in spirits brownish, with a dark round spot on dorsal above middle or a little posterior to middle of pectoral. In life the color of the body is olive brown, the spot bright greenish blue.

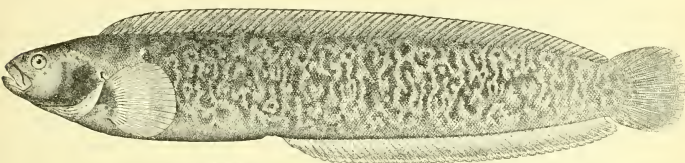


FIG. 22.—ABRYOIS AZUME.

Described from a specimen about 400 millimeters long from Mororan. Smaller specimens from the same locality are lighter in color, the spots being inky black; they have a narrow dark band extending downward and forward from eye, another downward and backward disappearing on cheek, a crescentic band on occiput connecting the eyes.

Type No. 7078. Leland Stanford Junior University. Cotype No. 50294, U.S.N.M.

Dorsal.	Anal.
LXI	II, 38
LXII	II, 40
LXIII	II, 37
LXI	II, 39
LXIII	II, 41
LXIII	II, 39

We have many specimens from Mororan and Otaru, where it occurs in the eel grass.

(*Azuma*, the poetical name for eastern Japan.)

20. PHOLIDAPUS Bean and Bean.

Pholidapus BEAN and BEAN, Proc. U. S. Nat. Mus., 1896, p. 389 (*grebnitskii*).

Body moderately elongate, compressed, covered with very small, smooth scales. Mouth small, horizontal; bands of small teeth on jaws and vomer, none on palatines. Head naked; gill membranes broadly connected, free from the isthmus; dorsal very long, composed entirely of flexible spines; anal of soft rays; caudal short, rounded, separate; no ventral fins; no lateral line; pyloric cæca present. This genus is

close to *Opisthocentrus*, but has no pungent spines, and the head is naked. Okhotsk Sea.

(*φολίς*, *Pholis*; *ἀπους*, without feet, i. e., ventral fins.)

- a. Dorsal spines, 62 to 64; dorsal fin with 1 to 3 dark ocelli *dybowskii*, 32.
 aa. Dorsal spines, 57; dorsal fin without ocelli *grebnitzkii*, 33.

32. PHOLIDAPUS DYBOWSKII (Steindachner).

Centronotus dybowskii STEINDACHNER, Ichth. Beiträge, IX, 1880, p. 22; Gulf of Strielok, near Vladivostock.—JORDAN and EVERMANN, Fish N. and M. Amer., III, p. 2430; Iturup Island.

Head $5\frac{1}{2}$ to $6\frac{2}{3}$; depth 6 to $6\frac{1}{2}$; D. LXII or LXIII; A. II, 39. Eye $3\frac{3}{8}$ to $4\frac{2}{3}$ in head; snout a little longer than eye; lower jaw scarcely included; 1 or 2 strong, conical teeth on each side behind the narrow premaxillary band of teeth; teeth on vomer, none on palatines; no cirri; large pores about eye and on opercles; longest dorsal spines $2\frac{1}{2}$ to 3 in depth of body, last spines shorter and stiffer than the others; dorsal and anal slightly joined to caudal; pectoral as long as caudal; about $1\frac{1}{4}$ in head. Head naked.

Brown or grayish, with faint spots or marblings; 1 or 2, rarely 3, dark ocelli on the dorsal; 3 or 4 dark streaks radiating from eye, the uppermost joining its fellow. Length 10 to 15 inches.

Sea of Okhotsk, north to the Kuril Islands. Our specimens, 5 in number, the longest 25 cm. long, from Shana Bay, Iturup Island. The scales are entire, strongly marked with concentric striae. The dorsal spines number 62, 63, 63, 64, 64. Dorsal ocelli are present on all our specimens, 2 of them being faintly visible, even in the youngest, 55 mm. long. (Named for Professor Dybowskii, its first collector.)

33. PHOLIDAPUS GREBNITZKII Bean and Bean.

Pholidapus grebnitzkii BEAN and BEAN, Proc. U. S. Nat. Mus., 1896, p. 390, pl. XXXIV; Volcano Bay, Japan. (Coll. Col. Nicolas A. Grebnitzki.)

This species from Volcano Bay, near Mororan, may differ in the smaller number of dorsal spines and in the absence of dorsal ocelli. Not having examined the types, we are not sure of its distinction from *Ph. dybowskii*.

The specimens are 141 mm. long, including caudal; 126 mm. to base of caudal. The head (22 mm.) is equal to the greatest depth of body. The eye is slightly longer than the snout and one-fourth as long as the head. The interorbital space is narrow, two-thirds of the length of the eye. The naked head resembles that of *Pholis*; its length is contained about $5\frac{1}{2}$ times in total length without the caudal. The mouth is small and very oblique; the mandible is slightly included and has a well-developed lip. The maxilla is partly concealed under the preorbital bone; it does not quite reach to below the anterior margin of the pupil. The anterior nostril is midway between the eye and the tip of the intermaxilla. Seven mucous pores around the

orbit; 3 on the preorbital bone. The pore in the origin of the semi-circular dark band around the nape is continued backward by a series of 6 similar ones, ending near the upper angle of the gill opening. A series of 10 or 11 pores, beginning near the front of the chin on each side, extending backward, and curving upward to the upper anterior edge of the operculum. The gill membranes are broadly united, but they are not joined to the isthmus. The dorsal origin is over the end of the head; the fin is low and consists of spines, the longest and strongest in the posterior third being slightly longer than the eye. The distance of the vent from the tip of the snout contains the head length $2\frac{2}{3}$ times. The anal is slightly lower than the dorsal, the rays longest posteriorly. The caudal is rounded, and is barely separated from the dorsal and anal. The pectoral base is broad, and the fin is two-thirds as long as the head. The intestine is slender and is more than twice as long as the head. Stomach short, pear shaped, with 6 slender, pyloric cæca of unequal length, the longest about twice as long as the eye. The body is completely scaled; the scales very small, cycloid, closely imbricated, with numerous concentric striae, and they extend halfway up the membrane, connecting the dorsal spines.

The general body color is brown; the sides sparsely and vaguely mottled. The pectorals are pale. A narrow dark band extends from the middle of the eye downward and forward, a similar band running backward from the eye on the preopercle; an interrupted semicircular band from eye to eye across the nape. D. LVII; A. II, 39 or 40. (Bean and Bean.)

(Named for Col. Nicolas Grebnitski, late governor of Komandorski, to whose industry and zeal the Museum is indebted for many valuable collections.)

21. ERNOGRAMMUS Jordan and Evermann.

Ernogrammus JORDAN and EVERMANN, Fish. N. and M. Amer., III, 1898, p. 2441 (*enneagrammus*).

This genus has the general characters of *Stichæus*, but there are 3 distinct lateral lines, each of which has numerous short, oblique branches, ending in a large pore, these not extending across to join the other lateral lines; dorsal high; pectorals and ventrals well developed; body not greatly elongate.

(ἔρνος, branch; γραμμή, line.)

- a. Dorsal spines about 41; pectoral banded; head with three oblique bands.
- b. Anal rays 28; depth 5 in length *hexagrammus*, 34
- bb. Anal rays 34; depth $6\frac{2}{3}$ in length *enneagrammus*, 35
- aa. Dorsal spines 49; anal rays 32; pectoral banded; head nearly plain... *epallax*, 36

34. ERNOGRAMMUS HEXAGRAMMUS (Schlegel).

Stichæus hexagrammus SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 136, pl. LXXIII, fig. 1; Bay of Shimabara, near Nagasaki.—GÜNTHER, Cat. Fish., III, 1861, p. 284.

Head $4\frac{1}{3}$ in length; depth 5; depth of caudal peduncle $3\frac{1}{2}$ in head; eye $5\frac{1}{2}$; interorbital space $10\frac{1}{2}$; snout 4. D. XLI; A. I, 28.

Body subcylindrical, head low, somewhat flattened above; interorbital space flat; snout pointed; jaws equal, maxillary extending almost to a point below posterior border of eye. Teeth in narrow bands on the jaws, vomer, and palatines. Gill membranes extending forward at their union, forming a V-shaped fold across the isthmus. Pseudo-branchiæ large; gill rakers on first arch, 8 or 10, very short and blunt. Nostrils with tubes; no tentacles on head.

Head naked; body closely covered with minute smooth scales. Lateral lines 3, with very short branches above and below, each ending in a large pore; the upper line extending from above gill opening to

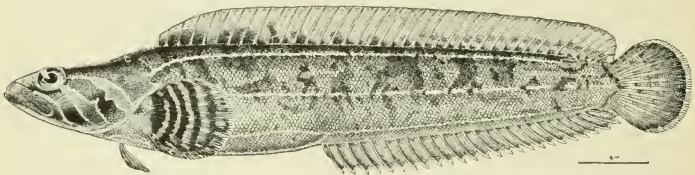


FIG. 23.—ERNOGRAMMUS HEXAGRAMMUS.

caudal; the median one passing from upper edge of base of pectoral to middle of caudal; the lower one originating in front of ventrals, dividing two branches just behind base of pectoral, passing backward along belly, the branches uniting at origin of anal and extending along base of that fin.

Dorsal spines not very rigid, highest behind middle of fin, 3 in head, membrane of fin rather thin, not incised between the spines, united to base of caudal; anal spine slender, small; highest rays $3\frac{1}{4}$ in head; pectoral rays much broadened toward their tips, the membrane incised between them; the fins rounded, $1\frac{1}{2}$ in head; ventrals equal in length to 2 times the diameter of eye.

Body with indefinite, dark, vertical bands, most evident on the younger specimens; side of head with 3 oblique, dark bands with white edges; dorsal dark, the posterior spine with whitish tips; anal narrowly edged with white; pectoral with 5 or 6 narrow, white bars; caudal edged with white, sometimes having a broad, whitish blotch on base.

Described from many specimens about 120 millimeters long from Hakodate. We have representatives from Hakodate and Otaru.

Although described from near Nagasaki, we obtained no specimens from southern Japan.

($\epsilon\zeta$, six; $\gamma\rho\alpha\mu\mu\acute{\eta}$, line.)

35. ERNOGRAMMUS ENNEAGRAMMUS Kner.

Stichæus enneagrammus KNER, Sitzber. Akad. Wiss. Wien, 1868, p. 16, pl. VI, fig. 19; Decastris Bay. (No. 1401c Mus. Wien.)

Ernoagrammus enneagrammus JORDAN and EVERMANN, Fish. N. and M. Amer., III, 1898, p. 2441, copied.

Head $3\frac{3}{4}$; depth $6\frac{2}{3}$. D. XLI; A. 33 or 34; P. 14 or 15. Eye 4 in head; as long as snout; mouth large, nearly horizontal, the maxillary reaching middle of eye; lower jaw projecting; profile of snout nearly horizontal; fine pointed teeth in bands on jaws and across the vomer; head naked; dorsal of high, slender spines; caudal separate, rounded; anal high; pectoral long, $1\frac{1}{2}$ in head; ventrals one-half as long as pectorals; scales very small, smooth; lateral lines each with short, oblique branches, each ending in a wide pore; 1 lateral line along base of caudal from head to caudal, 1 along middle of side, 1 along base of anal to caudal, this forking at the vent and sending 2 parallel branches forward to the breast.

Brownish; 2 rows of small, dark spots along middle lateral line; dorsal and anal with dark spots and a broad, dark margin; pectorals with 3 black cross bands; a dark bar at base of caudal; 3 black bars from eye.

Okhotsk Sea. Known from a specimen $1\frac{3}{4}$ inches long, from Decastris Bay (Kner). Not seen by us. The species is very close to *Ernoagrammus hexagrammus* and may prove to be the same. The anal rays a little more numerous.

($\epsilon\nu\nu\epsilon\alpha$, nine; $\gamma\rho\alpha\mu\mu\acute{\eta}$, line.)

36. ERNOGRAMMUS EPALLAX Jordan and Snyder, new species.

Head 5 in length; depth $7\frac{1}{3}$; depth of caudal peduncle $3\frac{2}{3}$ in head; eye $4\frac{1}{3}$; snout $4\frac{1}{2}$; interorbital space $13\frac{1}{2}$; D. XLIX; A. 1, 32.

Body slender; the head long and pointed; the snout sharp; interorbital space narrow, convex; lower jaw projecting slightly beyond the upper; maxillary extending to a vertical, through pupil. Teeth villiform, in broad bands on jaws, vomer, and palatines. Gill opening extending forward below, forming a V-shaped fold across the isthmus. Pseudobranchiae large; gill-rakers on first arch short. Nostrils with slender tubes, equal to two-thirds the length of the snout; no filaments. Numerous large mucous pores on various parts of the head.

Body covered with minute, cycloid, elongate scales; posterior part of dorsal membrane and basal part of caudal and pectoral with scales; head naked. Lateral lines 3; the first extending from a point just above gill opening, along upper part of body to near the caudal, with

long branches at short intervals extending toward the dorsal fin; the second line branches downward from the first above base of pectoral, and extends along median part of body to base of caudal, without long branches; the third line unites with the one on the opposite side of the body just behind the isthmus, extends backward, branching behind base of pectoral; the upper branch passes backward to near base of caudal fin, sending down several small lines toward the anal fin; the lower branch, which is connected with the upper one anteriorly by 3 or 4 cross lines, extends along belly to base of anal fin; each line has numerous, very short branches, which end in large pores.

Dorsal fin inserted a little behind base of pectoral, united posteriorly with the caudal; spines slender, slightly stronger posteriorly, the middle ones $2\frac{5}{8}$ in head; membrane of fin thin, not incised. Anal inserted below seventeenth spine of dorsal, not connected with the caudal, middle rays $3\frac{1}{2}$ in head; membrane thin, incised between the rays. Caudal rounded, $1\frac{1}{2}$ in head. Pectoral rather acutely rounded, $1\frac{1}{3}$ in head. Ventrals a little longer than diameter of eye.

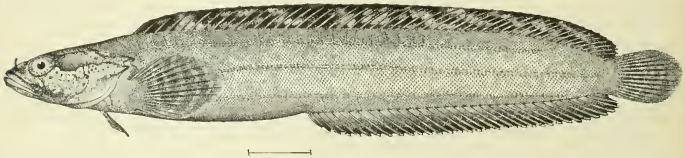


FIG. 24.—ERNOGRAMMUS EPALLAX.

Color in spirits brown; no lines or spots on head or body; fins all darker than the body, the dorsal with indistinct dark clouds, the anal narrowly edged with white posteriorly, the pectoral with 4 or 5 indistinct light vertical bands.

Described from a specimen 275 mm. long, from Otaru, loaned to us by Professor Nozawa, of the Fisheries Bureau at Sapporo.

(ἐπαλλάξ, crosswise.)

22. OZORTHE Jordan and Evermann.

Ozorth JORDAN and EVERMANN, Fish. N. and M. Amer., III, 1898, p. 2441 (*hexagrammus* = *dictyogrammus* Kner, not of Schlegel).

This genus has the general character of *Ernogrammus*, but besides the 3 chief lateral lines on each side there are two or more incomplete ones, and the lines are connected by numerous branches extending at right angles to them.

Ochotsk Sea.

(ὄζος, branch; ὀρθή, right angle.)

37. OZORTHE DICTYOGRAMMUS (Herzenstein).

Stichæus dictyogrammus HERZENSTEIN, Mélanges Biol., 1890, p. 121; Hakodate. *Stichæus hexagrammus* KNER, Sitzber, Akad. Wiss. Wien, 1868, p. 45; Decastris Bay, not of Schlegel.

Head $4\frac{3}{4}$ in length; depth 5; depth of caudal peduncle $2\frac{3}{4}$ in head; eye 6; snout 4; interorbital space $10\frac{1}{2}$. D. XLV.; A. I, 25.

Body rather deep and compressed; head pointed; interorbital space convex; jaws equal, maxillary extending to middle of eye. Teeth minute, in narrow bands on jaws, vomer, and palatines; gill-membranes continued forward below, forming a V-shaped fold across the isthmus. Gill-rakers on first arch 10, short, pointed. Pseudobranchiæ large. Nostrils with low tubes; no filaments on head.

Head naked; body covered with minute, closely apposed, cycloid scales. Lateral line system forming a complicated network; a complete lateral line passing from upper edge of base of pectoral to middle of caudal peduncle; one above this not quite complete posteriorly, the two connected by branches which are close together and regular

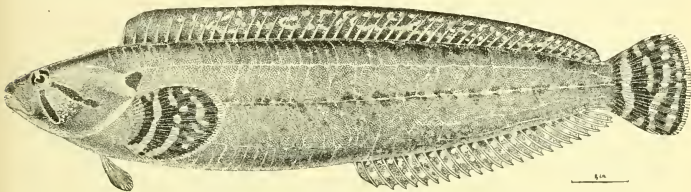


FIG. 25.—OZORTHE DICTYOGRAMMUS.

in position near the pectoral, further apart and irregular posteriorly; a third line extending along base of dorsal, connected with the second by cross lines; a fourth very irregular one extending on body above base of anal; a fifth passing along close to base of anal, connected with the one above it and this in turn connected with the first described line: the fourth line may in some specimens be traced forward to base of pectoral, while in others it is so short and broken as to scarcely appear as a line; a median line along belly connecting with branches on each side with the lateral lines.

Dorsal inserted a little anterior to base of pectoral, with stiff, pungent spines throughout, the middle ones highest, $2\frac{5}{8}$ in head; membrane of fin not greatly thickened, not incised between the spines, not connected with the caudal rays. Anal inserted below twenty-first dorsal spine, the spine short and slender, the rays highest on anterior third of fin, $2\frac{3}{4}$ in head; membrane incised between tips of rays, not connected with the caudal rays. Caudal rounded, $1\frac{1}{2}$ in head. Pectoral rounded, $1\frac{1}{4}$ in head, the edge incised, its length $1\frac{1}{4}$ in head; ventrals $2\frac{3}{4}$ in head.

Color in spirits dark brownish or blackish; a round black spot above upper edge of gill opening; eye with 3 dark bands radiating from it, the 2 on cheek most prominent, the other dark extending backward from eye, not evident on all examples; dorsal fin indistinctly spotted with blackish; pectoral and caudal with light vertical bands of irregular shape; anal with elongate light spots, the edge narrowly tipped with white; caudal tipped with white.

In life the spot on shoulder is steel blue and very conspicuous; the body is covered with bands and clouds of dull orange; a bright band on bases of caudal and pectoral.

Described from a specimen about 100 mm. long from Hakodate.

Dorsal.	Anal.
44	I, 23
44	I, 24
44	I, 23
43	I, 23
44	I, 23

We have many specimens from Hakodate, Nemuro, and Same.

(δίκτηρον, net; γραμμή, line.)

The following is the substance of Herzenstein's description of *Ozortho dictyogramma*:

Head 4; depth $4\frac{2}{3}$ in length of body (without caudal?); D. 44; A. 24 or 25; P. 14; V. 4. Eye $5\frac{2}{3}$ in head, nearly half greater than inter-orbital space.

Maxillary reaching to opposite front of middle of eye; mouth oblique; head with numerous pores; nostrils with short tubes midway between eye and tip of snout; teeth in broad bands on jaws, vomer, and palatines; head naked; a naked area between nape . . . dorsal and anal; body thickly scaled, lateral line somewhat variable, the upper runs from gill-opening above concurrent with the back, uniting itself near end of body with the middle line, which begins over the pectoral and ends at middle of caudal. From the upper line numerous cross branches run to the base of dorsal, where they form a network by means of a faint uppermost horizontal line; numerous vertical cross branches between upper and middle lateral line. From middle lateral line vertical branches run downward, which unite to form a line between ventrals and anal, more or less interrupted. Similar branches above the anal, where they unite partly in a line along base of anal. Branches of lateral line spreading over region before ventrals and pectoral.

Dorsal beginning over gill-opening and joined to base of caudal; longest spine 3 in head, the last and the first a little shorter; last anal rays reaching caudal; pectoral as long as from tip of snout to preopercle; ventrals nearly half as long as pectorals; caudal $7\frac{1}{2}$ to 8 in length of body.

Color apparently uniform; two or three dark stripes backward and downward from eye; dark spots on dorsal and anal and irregular dark cross streaks on pectoral and caudal.

Known from two specimens from Hakodate, collected by Maximowicz in 1863. (Herzenstein.)

23. STICHÆOPSIS Kner and Steindachner.

Stichæopsis KNER and STEINDACHNER, Sitzber. Akad. Wiss. Wien, 1870, p. 21 (*nana*).

Body moderately elongate, strongly compressed, scaleless. Head short, pointed. Jaws equal, with a band of fine-pointed teeth; no teeth on vomer and palatines. Dorsal rays all spinous, only the anterior ones flexible at tip, the others stiff. Dorsal, anal, and caudal united. Ventrals regularly formed, close together, each I, 4; jugular in position. Pectoral long, pointed; caudal short. Lateral lines, three, obscure, all incomplete.

Okhotsk Sea.

(*stichæus*, ♂ψ15, appearance.)

38. STICHÆOPSIS NANA Kner and Steindachner.

Stichæopsis nana KNER and STEINDACHNER, Sitzber. Akad. Wiss. Wien, 1870, p. 21; Decastris Bay.

Head 4 in total length $3\frac{1}{2}$ in body; depth 5; eye 4 in head; snout 4; D. XLVI; A. 20-21; C. 15; V. 5-5; P. 14.

Mouth oblique, maxillary extending to a point a little anterior to middle of eye. The upper of the strongly developed lateral lines begins at upper edge of gill-opening and extends to a point below base of tenth or twelfth dorsal spine. The second or middle one begins not far from the tip of depressed pectoral and ends above the middle of the body; the third extends above base of anal.

Body light brown, with irregular reddish-brown spots, which also occasionally occur on the dorsal. Anal with a dark border on the under side of the rays. Three dark bands radiate below and behind the eye. A dark-brown spot behind base of pectoral; a second at beginning of upper lateral line. Many brown specks on head, body, and fins.

A small specimen, somewhat over an inch long, from Decastris Bay. (Steindachner and Kner.)

Not seen by us.

(*nanus*, dwarf.)

24. STICHÆUS Reinhardt.

Stichæus REINHARDT, Dansk. Vidensk. Natur. og Math. Afhandl., 1837, p. 109 (*punctatus*).

Notogrammus BEAN, Proc. U. S. Nat. Mus., IV, 1881, p. 147 (*rotbroeki*); young.

Body moderately elongate, covered with small scales; teeth on jaws, vomer and palatines. Lateral line present, single, running alongside

of back; pectorals and ventrals well developed. Dorsal moderately high, of spines only; gill-openings continued forward below, the membranes scarcely united to the isthmus; pyloric cæca present.

Arctic seas.

(*στιχάω*, to set in rows.)

39. *STICHÆUS NOZAWÆ* Jordan and Snyder, new species.

Head 5 in length; depth $6\frac{2}{3}$; depth of caudal peduncle $3\frac{2}{3}$ in head; snout $5\frac{1}{2}$; eye $5\frac{1}{2}$; interorbital space 10; D. LI, A. I, 37.

Body compressed, head rather small and pointed. Eyes large, directed obliquely upward, interorbital space convex, suborbital area narrow. Lower jaw projecting beyond the upper, lips thin, maxillary extending to posterior border of eye. Teeth in narrow bands in the jaws, the outer ones somewhat enlarged; tips of jaws each with 2 canines, those of the lower jaw the larger; vomer and palatines with narrow bands of villiform teeth. Gill-openings forming a V-shaped fold across the isthmus. Pseudobranchiæ large; gill-rakers about $3 + 9$ short, flat. Nostrils with small tubes. No filaments on head.

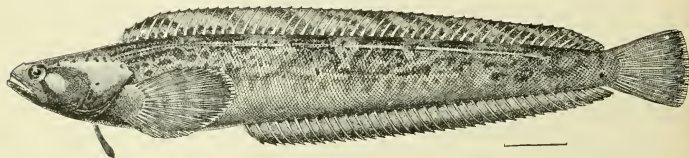


FIG. 26.—*STICHÆUS NOZAWÆ*.

Body covered with small smooth scales; membrane of dorsal and base of caudal with minute scales; head naked. Lateral line simple, extending from upper edge of gill-opening, along upper part of body to near the base of caudal, the pores in 2 rows.

Dorsal inserted above gill-opening, not united with caudal; the spines stiff, pungent, the middle ones contained about 4 times in head; membrane of fin not thickened, not incised between the rays. Anal inserted below fourteenth dorsal spine, the membrane thin, incised between the rays; middle rays $3\frac{1}{4}$ in head. Caudal slightly convex, $1\frac{1}{2}$ in head. Pectoral rounded, the lower rays shorter than the upper; length of fin contained about $1\frac{1}{6}$ times in head. Ventrals pointed, 3 in head.

Color in spirits light brown, indistinctly clouded with darker; small, blackish blotches along the lateral line; a brownish band extending downward from eye. A broad band, similar in color extending downwards and backward across cheek. Dorsal with 6 large blackish spots, the anterior one distinct, the others growing less definite posteriorly; scaled areas between the spines dark. Anal dark toward the edge, the rays tipped with white. Caudal, pectorals, and ventrals dusky.

Described from a single specimen 255 mm. long from Otaru, Hokkaido. The specimen was kindly loaned to us by Mr. S. Nozawa, director of the fisheries bureau at Sapporo, for whom we take pleasure in naming the species.

25. DINO GUNELLUS Herzenstein.

Dinogunellus HERZENSTEIN, Mélanges Biologiques, 1890, p. 121 (*grigorjewi*).

General characters of *Stichæus*, the body more robust, the head strongly depressed, the eyes small, directed upward, the mouth very wide. Lateral line single, of vertical pairs of pores, ceasing near base of caudal. The validity of this genus may be questioned.

(δεινός, terrible; *Gunellus*).

40. DINO GUNELLUS GRIGORJEWI (Herzenstein).

NAGAZUKA.

Stichæus grigorjewi HERZENSTEIN, Mélanges Biologiques, 1890, p. 119, "Mori on Volcano Bay" (probably Mororan).

Head $5\frac{1}{8}$ in length; depth $8\frac{1}{2}$; depth of caudal peduncle 5 in head; eye $13\frac{1}{2}$; interorbital space 10; snout $6\frac{1}{2}$; D. LVI, A. I, 43.

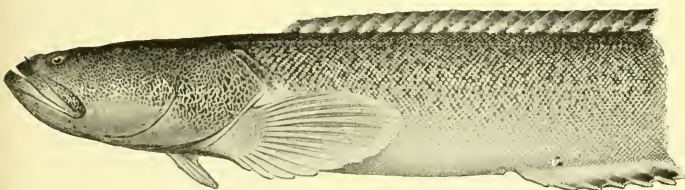


FIG. 27.—DINO GUNELLUS GRIGORJEWI.

Head large, greatly depressed, long and pointed. Eyes small, far forward, high in head, directed obliquely upward. Interorbital space concave. Mouth large, oblique, lower jaw projecting beyond the upper, maxillary extending far beyond eye, its length $2\frac{1}{2}$ in head. Lips large, the lower one thickened anteriorly. Teeth in bands on jaws, those in upper jaw minute, in narrow bands, those below larger, 2 narrow toothed areas extending forward at symphysis; teeth on vomer small, blunt; those on palatines enlarged, unequal in size, the largest about as long as diameter of pupil. Gill-membranes united extending forward below, forming a V-shaped fold across the isthmus. Pseudobranchiae large; gill-rakers very short, flat, covered with stiff cetae. Nostrils with short tubes. No filaments on head.

Body with minute, elongate, smooth scales; membrane of posterior part of dorsal and of basal part of caudal with scales; head naked. Lateral line with 2 rows of pores, extending along upper part of body, ending before reaching caudal fin.

Spines of dorsal stiff and sharp, those near middle of fin equal in length to snout; membrane of fin thin, not connected with caudal, not incised between the rays. Rays of anal near middle of fin, $4\frac{1}{2}$ in head; membrane thick, incised, free tips of rays fleshy. Caudal truncate, 2 in head. Pectoral rather pointed, the upper rays longest, $1\frac{1}{2}$ in head. Ventrals pointed, $4\frac{1}{2}$ in head.

Color in alcohol, whitish below, darker above; upper parts speckled with brownish black; anal edged with white, lower part of pectorals white, ventrals white.

Here described from a specimen 500 mm. long from Hakodate. An example almost as large from Mito, north of Tokyo, presented by the Imperial University, does not differ from the one described.

(Named for its discoverer, Grigorjew.)

26. LEPTOCLINUS Gill.

Ctenodon NILSSON, Skandinav. Faun., IV, 1853, p. 190 (*maculatus*) (name three times preoccupied).¹

Leptoclinus GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 209 (*aculeatus*).

Body much elongated; lateral line obsolete; teeth on jaws, vomer, and palatines; pectoral fins with the upper rays shortened; caudal fin subtruncate. Arctic seas. This genus is close to *Lumpenus*, differing mainly in the form of the pectoral.

(λεπτόεις, slender; *clinus*.)

41. LEPTOCLINUS MACULATUS (Fries).

Clinus maculatus FRIES, Kgl. Vet. Ak. Handl., 1837, p. 49; Bohüslin, Sweden.

Lumpenus aculeatus REINHARDT, Kong. Dansk. Vid. Selsk., VI, 1837, p. 190; no description.

Clinus aculeatus REINHARDT, Dansk. Vidensk. Selsk., Natur. Afh., VII, 1838, pp. 114, 122, 194; Spitzbergen.

Ctenodon maculatus NILSSON, Skand. Fauna, IV, 1853, p. 190.

Stichæus maculatus GÜNTHER, Cat., III, 1861, p. 281.

Lumpenus aculeatus KRÖYER, Naturhist. Tidsskr., I, 1862, p. 377.

Stichæus aculeatus GÜNTHER, Cat., III, 1861, p. 282.—COLLETT, Norske Nord-Havs Exp., 1880, p. 67.

Lumpenus maculatus JORDAN and GILBERT, Sydopsis, 1883, p. 777.—LILLJEBORG, Sveriges Och Norges Fish., 1891, p. 500.

Leptoclinus maculatus GILBERT, Rept. U. S. Fish Comm., 1893, p. 450.—JORDAN and EVERMANN, Fishes N. and M. Amer., III, p. 2433; Robben Island, Kadiak, Unimak Pass, Bristol Bay.

Head 5; depth 8; D. LX (LVIII-LX); A. 36 (35-38).

Eye large, $3\frac{1}{2}$ in head; snout short and blunt, $4\frac{3}{4}$ in head, maxillary reaching past middle of eye, $2\frac{1}{2}$ in head. Teeth in jaws, vomer, and palatines, jaws each having two strong canines in front. Scale small, cycloid. First 3 or 4 dorsal spines short and free; longest dorsal

¹*Ctenodon* Wagler, 1830, a lizard; Ehrenberg, 1838, a rotifer; and Swainson, 1839, a fish.

spines as long as eye, caudal fin free from dorsal and anal; ventrals 3 in head; pectorals rather large, $1\frac{1}{2}$ in head.

Color yellowish, irregularly marked with dark spots, a series of about 6 of these spots extending along sides close to base of dorsal fin; a series of smaller spots extending along center of sides from upper base of pectoral to caudal; dorsal irregularly covered with dark spots; caudal with 4 dark cross bands; anal, ventral, and pectorals plain yellowish.

Bering Sea to Spitzbergen, south to the Aleutian Islands, the Kurile Islands, and the coasts of Sweden and Norway. This description is taken from a specimen $5\frac{1}{4}$ inches long, from Alaska, near Unimak Pass (U. S. Fish Commission steamer *Albatross* Station 3309). A few young individuals of this species, formerly known only from the North Atlantic, were taken in Unimak Pass and Bristol Bay, in $29\frac{1}{2}$ to 70 fathoms. Three small specimens were also taken off Robben Island, near the coast of Saghalen, which is near the Japanese Kuriles, in 28 fathoms, and one off Karluk, Kadiak Island. The Pacific species should be compared with specimens from northern Europe. (*maculatus*, spotted.)

27. LUMPENUS Reinhardt.

Lumpenus REINHARDT, Dansk. Vidensk. Selsk. Natur., VI, 1837, p. 110 (*lumpenus=fabricii*).

Leptogunellus AYRES, Proc. Cal. Ac. Nat. Sci., I, 1854, p. 26 (*gracilis*).

Centrobrennius GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 209 (*nubilus*).

Leptobrennius GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 209 (*serpentinus*).

Anisarchus GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 209 (*medius*).

Body greatly elongate, moderately compressed, covered with small scales; lateral line indistinct or obsolete. Head long; snout short; no cirri; eyes placed high; mouth moderate, teeth in narrow bands on the jaws; palatine teeth present or absent; gill openings prolonged forward below, very narrowly united anteriorly to the isthmus, not forming a free fold across it. Dorsal composed of numerous, sharp, flexible, rather high spines; caudal fin long; anal many-rayed; pectorals large, more than one-half length of head, the middle rays longest; ventrals well developed, jugular 1, 3 or 1, 4; intestinal canal long; pyloric cæca present; no air bladder. Chiefly herbivorous. Northern seas.

(*Lumpen*, a Danish name of *Zoarces viviparus*, with which these fishes were at first confounded.)

a. LUMPENUS: Teeth on palatines, none on vomer.

b. Dorsal spines about 70; eye not much shorter than snout; fins with dark cross bands *anguillaris*, 42.

bb. Dorsal spines 75; eye much shorter than snout; fins all nearly plain. *fowleri*, 43.

42. LUMPENUS ANGUILLARIS (Pallas).

Blennius anguillaris PALLAS, Zoogr. Rosso-Asiat., II, 1811, p. 176; Kamchatka and Aleutian Islands.

Gunnellus anguillaris CUVIER and VALENCIENNES, Hist. Nat. Poiss., XI, 1836, p. 434.

Lumpenus anguillaris GIRARD, Pac. R. R. Surv., X, 1858, Fishes, p. 123, pl. XXV, figs. 1 to 3.—STOREY, Synopsis, 1846, p. 121.—JORDAN and GILBERT, Synopsis, 1883, p. 777.—JORDAN and STARKS, Fishes Puget Sound, 1895, p. 848.—JORDAN and EVERMANN, Fishes N. and M. Amer., III, p. 2436.

Stichæus anguillaris GÜNTHER, Cat., III, 1861, p. 282.

Leptogunellus gracilis AYRES, Proc. Cal. Ac. Nat. Sci., I, 1855, p. 26; San Francisco.

Head 8; depth 14; D. LXXI; A. 46 (45-50); V. I, 4; B. 7.

Cheeks scaly; mouth somewhat oblique, the lower jaw included; maxillary reaching front of pupil; teeth on palatines, none on vomer; a single series of rather long, conical, and not very closely-set teeth in each jaw. Eye rather large, not much shorter than snout. Gill openings prolonged forward a distance greater than length of snout; pyloric cæca 4, unequal. Fins all comparatively high, pectorals two-thirds length of head, the middle rays longest; ventrals one-third length of head; dorsal and anal distinct from the pointed caudal, which is nearly as long as the head. Olive green above, pale below; sides marked above with dark olive brown; a series of more or less distinct oblong blotches of olive brown along middle of sides; dorsal barred or spotted and pale; opercle with a dark blotch; head dusky above. Length 18 inches. San Francisco to Alaska; very abundant northward to Sitka and Unalaska; originally recorded from Kamchatka. (Jordan and Evermann.)

A specimen in the museum at Hakodate from Tarumai near Moran, probably belongs to this species. D. LXX; pectoral longer than head; ventrals 4 in head, equal to snout; maxillary $3\frac{3}{4}$ in head, reaching front of pupil.

(*anguillaris*, eel-like.)

43. LUMPENUS FOWLERI Jordan and Snyder, new species.

Stichæus islandicus ISHIKAWA, Prel. Cat., 1897, p. 35, No. 599; Nemuro. (Not of authors; an Iceland species.)

Head $7\frac{1}{2}$ in length; depth 11; depth of caudal peduncle 4 in head; snout $4\frac{1}{2}$; eye 7; interorbital space 15; D. LXXV; A. II, 47.

Eyes directed almost laterally, much smaller than length of snout. Maxillary extending to a vertical through anterior edge of pupil. Teeth in narrow bands on the jaws, the outer ones scarcely larger than the others; vomer without teeth; palatines with a small band of minute teeth. Gill-membranes narrowly united to the isthmus. Pseudobranchiæ large; gill-rakers on first arch about $2 + 10$, short, pointed. Nostrils with low rims. No tentacles on the head.

Cheeks with scales, a broad band extending from mouth, backward

and upward along cheek and side of head, uniting with scales of body; snout, top of head, chin, throat, opercle and space along preopercle naked; body covered with minute scales; membranes of dorsal and anal naked, membranes of caudal with minute scales between the rays.

Dorsal inserted immediately above gill-opening; spines strong, the anterior ones short, about equal to diameter of pupil, the posterior ones more slender, longer, $3\frac{1}{5}$ in head; membrane of dorsal thin, not connected with the caudal. Anal inserted below twenty-eighth spine of dorsal. The spines short, rather blunt, the rays longest on anterior third of fin, $2\frac{1}{5}$ in head; membrane of fin thin, with shallow incisions between the rays, not connected with the caudal. Caudal rounded, $1\frac{1}{2}$ in head. Pectoral sharply rounded, $1\frac{1}{5}$ in head. Spine of ventral stout, the fin small, pointed, 4 in head.

Color in spirits light yellowish brown, a dark brown band with irregular margins along base of dorsal, a broken band about as wide as pupil, forming a row of elongate brown spots extending from upper

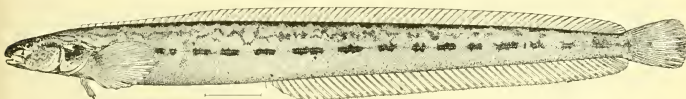


FIG. 28.—LUMPENUS FOWLERI.

edge of gill-opening to base of caudal, small clouds of brown on upper half of body; top of head mottled with brown, cheeks with indistinct spots, opercles with a blackish spot, the membrane lining gill-chamber blackish. Fins without bands or spots, except a small, indistinct spot near base of caudal.

Described from a specimen 315 mm. long, type 7079, Stanford ichthyological collections, from Kushiro; presented by Mr. Nozawa, director of the museum of Sapporo.

The species differs notably from *Lumpenus anguillaris* in having a smaller eye, more spines in the dorsal, and in not having banded fins; the ventral is also probably shorter, being about equal to snout.

A specimen in the Imperial Museum (No. 599) from Nemuro probably belongs to this species. D. LXXVI; P. $1\frac{1}{4}$ in head; ventral not longer than snout; maxillary reaching to middle of eye. A specimen in the museum at Hakodate, also probably belonging to this species rather than to the preceding one, has 75 spines in the dorsal.

(Named for Mr. Henry Weed Fowler.)

Family II. ANARHICHADIDÆ.

WOLF-FISHES.

Body oblong or elongate, covered with rudimentary scales; no lateral line. Head scaleless, without cirri, its bones very thick and strong, the profile strongly decurved. Mouth very large, oblique,

the jaws anteriorly with very strong conical canines; sides of lower jaw with very strong molar teeth, which shut against a series of very coarse molars on the palatines; vomer solid, armed with strong molar teeth, the dentition adapted for crushing sea-urchins and mollusks. Gill membranes broadly united to the isthmus; no pyloric cæca. Dorsal fin high, composed entirely of flexible spines; no ventral fins; pectoral fins broad, placed low. Large carnivorous fishes of the northern seas.

ANARHICHADINÆ:

- a. Body moderately elongate, the tail not tapering to a point; dorsal and anal separate from the caudal.....*Anarhichas*, 28.

28. ANARHICHAS (Artedi) Linnæus.

Anarhichas (Artedi) LINNÆUS, Syst. Nat., 10th ed., 1758, p. 247 (*lupus*).

Body moderately elongate, covered with rudimentary scales; head scaleless, without cirri, compressed, narrowed above, the profile strongly decurved; mouth wide, oblique; premaxillary not protractile; jaws with very strong conical canines anteriorly; lateral teeth of lower jaw either molar or with pointed tubercles; upper jaw without lateral teeth; vomer extremely thick and solid, with 2 series of coarse molar teeth; palatines with 1 or 2 similar series. Gill-membranes broadly joined to the isthmus; no lateral line. Dorsal fin rather high, composed entirely of flexible spines, which are enveloped in the skin; anal fin lower; caudal fin developed, free from dorsal and anal; no ventral fins; pectoral fins broad, placed low; air-bladder present; no pyloric cæca. Northern seas. (*Anarhichas* or *Scansor*, the climber; an ancient name of *Anarhichas lupus*; from ἀναρρίχάζομαι, to climb or scramble up—the allusion not evident, the word spelled with a single ρ by Artedi and Linnæus.)

44. ANARHICHAS (species not described).

A large stuffed specimen of an *Anarhichas* is in the museum at Hakodate, from the Aino village of Mombetsu, province of Iburī, in Hokkaido. It is plain dark, with darker cross-bands; two rows of teeth on vomer and palatines. Head $5\frac{1}{2}$ in length. Unfortunately our notes are not sufficient to distinguish this from the European species *Anarhichas lupus* Linnæus, the only one with which it need be compared. It is to be hoped that some Japanese naturalist will complete the account of this interesting wolf-fish.

SUMMARY.

Family I. BLENNIIDÆ.

1. *Tripterygion* Risso.

1. *etheostoma* Jordan and Snyder; Misaki, Wakauoura, Atami.
2. *bapturum* Jordan and Snyder; Misaki.

2. *Zacalles* Jordan and Snyder.

3. *bryope* Jordan and Snyder; Misaki, Wakanoura, Enoura.

3. *Blennius* Linnaeus.

4. *yatabei* Jordan and Snyder; Misaki, Enoshima, Wakanoura.

4. *Petroscirtes* Rüppell.

5. *elatus* Jordan and Snyder; Ishigaki.

5. *Aspidontus* Cuvier.

6. *elegans* (Steindachner); Hakodate, Enoshima, Misaki, Wakanoura.

7. *trossulus* Jordan and Snyder; Misaki.

8. *dasson* Jordan and Snyder; Wakanoura, Agn.

9. *japonicus* Bleeker.

6. *Salarias* Cuvier.

10. *ceramensis* Bleeker; Ishigaki.

7. *Scartichthys* Jordan and Evermann.

11. *enosima* Jordan and Snyder; Enoshima, Yogashima, Misaki.

12. *stellifer* Jordan and Snyder; Wakanoura.

8. *Azuma* Jordan and Snyder.

13. *enunio* Jordan and Snyder; Hakodate, Miyako.

9. *Bryostemma* Jordan and Starks.

14. *polyactocephalum* (Pallas).

15. *otohime* Jordan and Snyder; Hakodate.

16. *saitone* Jordan and Snyder; Aomori.

10. *Enedrias* Jordan and Gilbert.

17. *nebulosus* (Schlegel); Hakodate, Aomori, Otaru, Matsushima, Tokyo, Misaki, Onomichi.

11. *Pholis* Scopoli.

18. *pictus* (Kner); Stump.

19. *dolichogaster* (Pallas); Robben.

20. *taczanowskii* (Steindachner); Hakodate.

21. *fasciatus* (Bloch and Schneider); Aomori.

12. *Gunnellops* Bleeker.

22. *rosca* (Pallas).

13. *Alectrias* Jordan and Evermann.

23. *benjamini* (Jordan and Snyder); Hakodate.

14. *Eulophias* H. M. Smith.

24. *tanneri* H. M. Smith.

15. *Neozoarces* Steindachner.

25. *pulcher* Steindachner.

26. *steindachneri* Jordan and Snyder; Hakodate, Otaru.

16. *Zoarchias* Jordan and Snyder.

27. *veneficus* Jordan and Snyder; Mororan, Otaru, Hakodate.

17. *Dictyosoma* Schlegel.28. *burgeri* Van der Hoeven; Aomori, Tokyo, Misaki, Wakanonra.18. *Opisthocentrus* Kner.29. *ocellatus* (Tilesius); Hakodate, Aomori, Mororan, Otaru.30. *zonope* Jordan and Snyder; Mororan, Otaru.19. *Abryois* Jordan and Snyder.31. *azumae* Jordan and Snyder; Mororan, Otaru.20. *Pholidopus* Bean and Bean.32. *dybowskii* (Steindachner); Iturup.33. *grebnitzkii* Bean and Bean.21. *Ernogrammus* Jordan and Evermann.34. *herogrammus* (Schlegel); Hakodate, Otaru.35. *enneagrammus* Kner.36. *epallax* Jordan and Snyder; Otaru.22. *Ozortho* Jordan and Evermann.37. *dictyogrammus* (Herzenstein); Hakodate, Nemuro.23. *Stichvopsis* Kner and Steindachner.38. *nana* Kner and Steindachner.24. *Stichæus* Reinhardt.39. *nozawae* Jordan and Snyder; Otaru.25. *Dinogunellus* Herzenstein.40. *grigorjewi* (Herzenstein); Hakodate, Mito.26. *Leptoclinus* Gill.41. *maculatus* (Fries); Robben Island.27. *Latipennis* Reinhardt.42. *anguillaris* (Pallas); Tarnmaï.43. *fowleri* Jordan and Snyder; Kushiro, Nemuro, Hakodate.

Family II. ANARHICADIDÆ.

28. *Anarhicus* Linnaeus.44. *species undetermined*; Mombetsu.

A NEW FRESH-WATER ISOPOD OF THE GENUS MANCASELLUS FROM INDIANA.

By HARRIET RICHARDSON,

Collaborator, Division of Marine Invertebrates.

The species herein described as new was collected by Mr. L. E. Daniels at Lily Lake, Laporte, Indiana, and sent to the United States National Museum. *Mancasellus danielsi* is the fifth known species of the genus *Mancasellus*, *M. brachyurus* Harger, *M. tenax* Harger, *M. macrourus* Garman, and *M. lineatus* (Say) having been previously made known, and one subspecies, *M. tenax dilata* Harger.

Family ASELLIDÆ.

MANCASELLUS Harger.

MANCASELLUS DANIELSI, new species.

Body broadly oval, with lateral parts of segments widely expanded. Head broader posteriorly than anteriorly, the posterior part being as wide as the first thoracic segment. Lateral margins have a deep and wide incision which separates the narrower anterior lobes from the widely expanded posterior lobes. The eyes are opposite these incisions. The frontal margin is produced in a small median point, on either side of which is a shallow depression, followed by another point, in turn succeeded by a slight depression. The antennulæ are short, reaching only to the extremity of the fourth joint of the peduncle of the antennæ; the flagellum contains eight joints. The antennæ are very long, extending nearly the entire length of the body. The mandible is without a palp.

The thoracic segments are subequal in length. The lateral parts are widely expanded, with lateral margins entire.

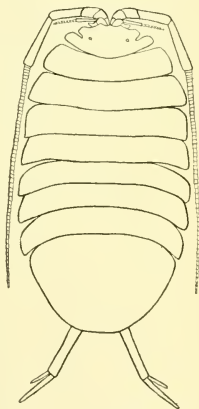


FIG. 1.—MANCASELLUS DANIELSI. $\times 31$.

The caudal segment is narrower posteriorly than anteriorly, with the end obtusely rounded. Width of segment at base about one and one-half times its length.

The caudal stylets are long and slender, the length of the stylet being equal to the length of the caudal segment. The basal joint is equal to the length of the fifth peduncular joint of the antennae. The outer branch is half as long as the inner branch.



FIG. 2.—MANDIBLE OF MANCASELLUS DANIELI.

The first pair of legs are subchelate. The propodus is broadly expanded and armed on the inner margin with a large tooth about halfway between the base and the articulation of the joint with the dactylus. Between the tooth and the articulation of the dactylus with the propodus is a process having a blunt, truncate extremity. The dactylus is provided with two teeth near the base on the inner margin. The carpus is small and triangular in shape. The merus is produced at the upper outer angle.

The remaining six pairs of legs are similar in structure and ambulatory in character, with biunguiculate dactyli.

Three specimens were found at Lily Lake, Laporte, Indiana, by Mr. Daniels.

Type.—Cat. No. 25693, U.S.N.M.

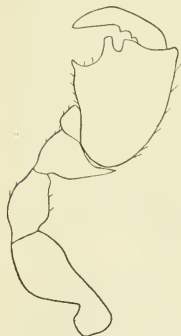


FIG. 4.—LEG OF FIRST PAIR OF MANCASELLUS DANIELI. $\times 14\frac{1}{2}$.

This species is more closely related to *M. tenax* Harger than to any other species of the genus. It differs, however, from *M. tenax* in the greater length of the antennae, which extend nearly the entire length of the body, while in *M. tenax* they are only half the length of the body; in the greater width of the caudal segment in proportion to its length, the width being one and one-half times the length,

while in *M. tenax* the width and length of this segment are about equal; in the greater length of the caudal stylets, which are equal to the length of the caudal segment, while in *M. tenax* they are only a little longer than half the length of the caudal segment; in the greater length of the basal segment of the stylet, its length being equal to the length

The first pair of legs are subchelate. The propodus is broadly expanded and armed on the inner margin with a large tooth about halfway between the base and the articulation of the joint with the dactylus. Between the tooth and the articulation of the dactylus with the propodus is a process having a blunt, truncate extremity. The dactylus is provided with two teeth near the base on the inner margin. The carpus is small and triangular in shape. The merus is produced at the upper outer angle.

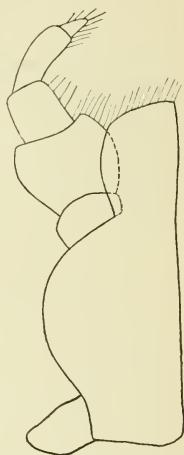


FIG. 3.—MAXILLIPED OF MANCASELLUS DANIELI. GREATLY ENLARGED.

of the fifth joint of the peduncle of the antennæ, while in *M. tenax* it is equal to the length of the fourth joint of that organ (the fourth joint of the peduncle of the antennæ in both species being shorter than the fifth joint); in the greater breadth of the entire body in proportion to its length, *M. tenax* being narrower in width as compared to its length; and in the difference in the legs of the first pair, the propodus in *M. tenax* being armed with one broad low tubercle (in the sub-species *dilata* the propodus is armed with three acute teeth), while in *M. danielsi* the propodus is armed with one large tooth and one bluntly ending, truncate process, the dactylus being provided with two teeth at the base, the dactylus in *M. tenax* being armed with spines on the inner margin, of which the distal ones are the larger, and at the end with a large spine.

This species differs from *M. lineatus* (Say) in having antennæ somewhat shorter, in the fact that the propodus of the first pair of legs is provided with a bluntly ending process between the long tooth, situated about the middle on the inferior margin, and the articulation of the dactylus with the propodus; and in the longer outer branch of the caudal stylets, it being half as long as the inner branch, while in *M. lineatus* it is only one-third the length of the inner one.

Named for Mr. L. E. Daniels, by whom the specimens were collected.

A NEW TERRESTRIAL ISOPOD OF THE GENUS PSEUD-
ARMADILLO FROM CUBA.

By HARRIET RICHARDSON,

Collaborator, Division of Marine Invertebrates.

Only one species of this genus is known, *Pseudarmadillo carinulatus* Saussure. The species herein described, to which the name *P. gillianus* is given, was collected at Nueva Verona, Isla de Pinos, Cuba, by Messrs. Palmer and Riley. Only a single specimen was sent to the United States National Museum.

Family ARMADILLIDIDÆ.

PSEUDARMADILLO Saussure.

PSEUDARMADILLO GILLIANUS, new species.

Body strongly and thickly tuberculate. The thorax is armed with two longitudinal rows of long stout spines, each row being halfway between the median line and the lateral margin. On the seventh thoracic segment, however, the spines are closer together and are much longer. A long median spine is present on the fifth abdominal segment.

The head has the anterior margin produced in three lobes; a median lobe, which is broad and roundly truncate, and two lateral lobes, broadly rounded. The posterior portion of the head bears four prominent tubercles in a transverse series, the two outer ones being much larger and stouter, with broad bases. The eyes are black and distinct and are situated post-laterally. The antennæ reach the middle of the first thoracic segment; the flagellum is two-jointed, the proximal joint being three or four times shorter than the distal one.

The first thoracic segment is covered with small tubercles, except at the sides. The posterior portion of the lateral part of the segment is produced backward a little, the post-lateral angulation being rounded. The lateral border is curved upward, forming a slight concavity. On either side of the segment halfway between the median line and the lateral margin, and on the posterior part of the segment, is a long

stout spine, directed backward. The coxopodites are distinct the entire length of the first segment on the under side and each is in the form of a ridge, ending in a bifurcate tooth-like process. The second thoracic segment has the coxopodites of the under side in the form of tooth-like processes. The lateral spines of the second, third, fourth, fifth, and sixth segments form two longitudinal series, one on either side of the median line, halfway between that and the lateral margin, and in line with those of the first segment. The spines of the seventh thoracic segment are, however, much closer together and are also much longer. The seventh segment is produced backward about the center, so that it is longer at that point than at the sides. The lateral portions of the second, third, fourth, and fifth segments are drawn out in narrow rounded processes, slightly curving upward at their extremities. The sixth and seventh segments have the lateral portions drawn out in processes which are somewhat truncate at their extremities. All these segments are thickly tuberculate except at the sides and on the anterior portion, where the segment articulates with the one immediately anterior to it.

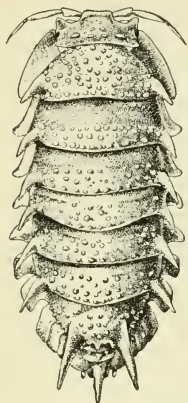


FIG. 1.—PSEUDARMADILLO
GILLIANUS. $\times 5$.



FIG. 2.—ABDOMEN OF
PSEUDARMADILLO
GILLIANUS. $\times 5$.

The first two segments of the abdomen are concealed by the last thoracic segment. All the abdominal segments are tuberculate. One tubercle in the median line of the third segment is somewhat enlarged and more prominent than the others. One tubercle in the median line of the fourth segment is slightly more enlarged than the tubercle of the preceding segment. A long stout spine directed backward is present on the fifth abdominal segment in the median line. At the base of the terminal segment is a large prominent tubercle, very much larger than those of the third and fourth abdominal segments. The terminal segment is triangularly shaped, with the apex produced in a truncate process. The basal segment of the uropoda, seen from the dorsal side, is large, wider at the base than at the apex, filling the space between the lateral process of the fifth abdominal and the terminal abdominal segment, and continuing the oval outline of the body. The outer branch is very small and is inserted at the posterior angle of the basal joint. The basal joint, seen from the under side, is very large, triangular in shape, the basal joint of either uropod meeting in the median line at the upper



FIG. 3.—LATERAL
VIEW OF ABDO-
MEN. $\times 5$.

at the base than at the apex, filling the space between the lateral process of the fifth abdominal and the terminal abdominal segment, and continuing the oval outline of the body. The outer branch is very small and is inserted at the posterior angle of the basal joint. The basal joint, seen from the under side, is very large, triangular in shape, the basal joint of either uropod meeting in the median line at the upper

inner angle. From this angle the inner branches of the uropoda extend in the form of narrow elongate processes, broader at the apex than at the base and not quite reaching the posterior extremity of the terminal abdominal segment.

A single specimen, a female, was collected by Messrs. Palmer and Riley in Cuba at Nueva Verona, Isla de Pinos, July 10, 1900.

Type.—Cat. No. 25694, U.S.N.M.

This species differs from the type and only species of the genus *Pseudarmadillo carinulatus* Saussure,¹ in the presence of two longitudinal rows of long stout spines on the thorax, a row on either side of the median line halfway between that and the lateral margin, while in the description of *P. carinulatus* only two tubercles (not spines) are mentioned as being present on the thorax, the last thoracic segment alone being armed with two large triangularly shaped (triquètres) tubercles; in the absence of the longitudinal carinae, mentioned in the description of *P. carinulatus* as being present on the lateral parts of the thoracic segments and the third abdominal segment; in the presence of a large spine on the fifth abdominal segment in the median line, which is represented in *P. carinulatus* by a strong tubercle, and in the presence of eyes, which are wholly wanting in *P. carinulatus*.



FIG. 4.—ABDOMEN AND UROPODA (UNDERSIDE). $\times 9\frac{1}{2}$.

Named for Dr. Theodore Gill, the eminent naturalist.

¹ Mém. de la Soc. de Physique et d'Histoire Naturelle de Genève, XIV, 1858, p. 483-485, pl. v, fig. 43

A REVIEW OF THE CHELETODONTIDÆ AND RELATED FAMILIES OF FISHES FOUND IN THE WATERS OF JAPAN.

By DAVID STARR JORDAN and HENRY W. FOWLER,
Of the Leland Stanford Junior University.

In the present paper an account is given of the Japanese fishes belonging to the *Cheletodontidæ* and to the more or less closely related families of *Zeidæ*, *Antigonidæ*, *Platacidæ*, *Acanthuridæ*, and *Siganidæ*. The account is based on material collected in 1900 by Jordan and Snyder under the auspices of the Hopkins Seaside Laboratory of Stanford University, in connection with the series in the United States National Museum, and some specimens collected by the U. S. Fish Commission steamer *Albatross*.

The families included in this paper may be thus distinguished:

- a. Ventral rays, I, 6 to I, 8; scales minute or wanting; pubic bone short; post-temporal firmly attached to the skull.
- aa. Ventral rays, I, 5 ZEIDÆ, I.
- b. Teeth very small, not brush-like nor united; gill-membranes separate, free from isthmus; pelvis very long; scales etenoid ANTIGONIDÆ, II.
- bb. Teeth elongate, brush-like or incisor-like; gill-membranes united to the broad scaly isthmus; soft scaly fins.
- c. Post-temporal bifurcate or trifurcate, not united with the skull; teeth slender, hardly brush-like; maxillary distinct; dorsal spines not separated from the soft rays; body very deep; soft dorsal, anal, and ventrals much elevated PLATACIDÆ, III.
- cc. Post-temporal apparently simple, firmly united to the skull; dorsal fin continuous.
- d. Teeth brush-like, setiform, thick-set; post-temporal with a foramen which is usually fully perforate; carnivorous fishes with the intestinal canal short; the caudal peduncle unarmed and the pubic bone not greatly developed; maxillary distinct.
- e. Scales well developed CHELETODONTIDÆ, IV.
- cc. Scales reduced to minute asperities; some of the dorsal spines filamentous ZANCLIDÆ, V.
- dd. Teeth incisor-like, in a single series; post-temporal with a foramen which does not pass through the bone; scales minute, rough; herbivorous fishes with the intestinal canal elongate; the caudal peduncle usually armed with spines or tubercles; maxillary and premaxillary immovably united; post-temporal united with skull; pubic bones very long, bent, firmly attached to each other ACANTHURIDÆ, VI.
- aaa. Ventral rays, I, 3, I; anal spines, seven; dorsal spines thirteen; scales minute, cycloid; teeth incisor-like SIGANIDÆ, VII.

Family I. ZEIDÆ.

JOHN DORIES.

Body short, deep, much compressed and elevated, naked or covered with minute, smooth scales, or with bony protuberances. Mouth large, terminal, the upper jaw protractile. Teeth small, in narrow bands or single series on the jaws and vomer, and sometimes on the palatines. Eyes lateral, placed high; opercle much reduced; some of the bones of head usually with spines; preopercle not serrate. Post-temporal very firmly attached to the skull; lower limb adnate for its whole length; the distal end only of its upper limb is attached. The supra-clavicle short and triangular, bearing a short spine near its anterior angle, its posterior edge divided into three spines, two or three of which stand out above the surface of the skin. Ventral edge often serrate, with strong bony plates. Lateral line well developed, concurrent with the back. Branchiostegals, 7 or 8. Gill-openings wide, the membranes little united, free from the isthmus. Pseudo-branchiæ large. Air bladder large. Gill rakers usually short; gills 4, no slit behind the fourth. Dorsal fin emarginate or divided, the anterior part with spines, which are often strong, the posterior part longer, its highest rays behind the middle; soft anal entirely similar to soft dorsal, usually preceded by 1 to 4 spines, which are not graduated and which often form a separate fin: pubic bone short; ventral fins thoracic, well developed, their rays usually I. 6 to I. 8; pectorals small; caudal fin rounded, on a moderate peduncle. Lateral line obscure, unarmed. Pyloric cæca exceedingly numerous. Vertebrae about 32 (*Zeus*). Fishes of singular appearance, inhabiting warm seas, often at considerable depth. The species undergo great changes in the course of development. The "John Dory" (*Zeus faber*) is a well-known food-fish of southern Europe. The increased number of ventral rays and the armature of the belly in this family suggest relationship with the Berycoids; the adnate post-temporal suggests the Chætodonts. We follow Mr. Starks in associating the *Zeidæ* with the Chætodonts, removing them from all association with the Scombroïd forms, to which they bear only the most superficial resemblance. The actual place of *Zeus* in the system is still uncertain, but it should not be separated far either from the Berycoids or the Chætodonts.

- a. Dorsal spines very strong, sometimes filamentous; anal spines 3 or 4. Bony spinous plates present along bases of vertical fins, and between ventrals and anal.
- b. Anal spines 3; both dorsals with strong bony spinous plates at base; ventral rays I, 6, or I, 7.....*Zenopsis*, 1.
- bb. Anal spines 4; no plates at base of spinous dorsal; scales evident....*Zeus*, 2.
- bbb. Anal spines 2, the first strong, immovable; bony plates very small; scales obsolete.....*Cyttopsis*, 3.

1. ZENOPSIS Gill.

Zenopsis GILL, Proc. Ac. Nat. Sci. Phila., 1862, p. 126 (*nebulosus*).

Body ovate, much compressed, without scales and without warts or humps in the adult. Head deeper than long, its anterior profile steep. Mouth rather large, upper jaw protractile; teeth small on jaws and vomer, none on the palatines. Various bones of the head and shoulder girdle armed with spines. Series of bony plates along the sides of the belly and the bases of both dorsal and anal, each plate armed with a strong spine with radiating striae at the base. Gill rakers short. Dorsal spines very strong, usually 10 in number, some of them filamentous; anal spines 3; ventral fins long, the rays I, 6, or I, 7. Caudal peduncle slender, the fin not forked. This genus differs from *Zeus* mainly in the presence of 3 anal spines instead of 4, and in the greater development of the spinous armature.

(Ζήνυ, a poetic form of Ζεύς, Jupiter; ὄψις, appearance.)

1. ZENOPSIS NEBULOSA (Schlegel).

KAGAMIDAI (MIRROR TAI OR PERCH).

Zeus nebulosus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 123, pl. LXVI; Nagasaki.—GÜNTHER, Cat. Fish, II, 1860, p. 395; Japan.—STEINDACHNER and DÖDERLEIN, Fische Japans, IV, 1884, p. 14; Tokyo.—NYSTROM, Svensk. Ak. Handl., 1887, p. 32; Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 43; Tokyo.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 359; Tokyo.

Head $2\frac{1}{2}$; depth $1\frac{1}{2}$. D. IX or 10–27; A. III–25; P. 12; V. 1–6. Body short, deep, compressed and elevated. No scales; the skin naked and smooth; 12 to 14 bony bucklers along the base of the dorsal fin on each side, each armed with a short curved spine, which is directed outward and backward, and marked with radiating ridges; along the abdominal ridge of the body from the gill-opening are a series of bony bucklers on each side, which are 3 before ventrals, 8 between the latter and anal, and 7 or 8 along the base of the anal; the dorsal bucklers are smallest at base of spinous dorsal, becoming enlarged at the middle of the soft dorsal; the bucklers before ventral are very small, the middle ones between the base of the ventral and anal and along the base of the latter the largest. Head long, deep, and obliquely quadrangular, the upper profile concave; snout short; eye moderate, high, $1\frac{1}{2}$ to $1\frac{2}{3}$ in snout, $3\frac{2}{3}$ to 4 in total length of the head, and $1\frac{1}{2}$ to $1\frac{2}{3}$ in maxillary; anterior margin of eye nearer the posterior margin of the opercle than the tip of the snout; mouth large, deep, obliquely vertical, and with the mandible protruding; the maxillary broad distally for about three-fifths to two-thirds the diameter of the eye, and not extending posteriorly below in front of the eye; lips very broad and thin; teeth small in both jaws and directed inward; nostrils close together, directly in

front of the eye, and the posterior very much larger than the anterior; above the eye a number of small denticles in a single series on each side; distal extremities of the articulators produced into two small spines below; dentaries with two small spines at the symphysis below; edge of preoperculum very long and oblique and the angle very obtuse and rounded; top of head with two ridges between the eyes, the inter-orbital space two-thirds to five-sixths in the eye. Gill-opening very large, its lower margin at least twice that of the upper; gill rakers short, stumpy, rounded, and few; no slit behind the fourth gill-arch.

Origin of spinous dorsal behind the eye; the spines thick and strong, terminating in long, thread-like filaments, and highest anteriorly; origin of soft dorsal about over the first anal spine, the fin, like the soft anal, with the posterior rays the longer; anal spines graduated from the first, which is the largest and only a little longer than the eye; pectoral a trifle in advance of the base of the first dorsal spine, about equal to the snout, and with its upper rays the longer; ventrals a little in front of the middle of the eye, $1\frac{2}{3}$ to $1\frac{3}{4}$ in body, the middle rays the longest and the innermost the shortest; caudal short, the edge convex, and 2 to $2\frac{1}{2}$ in the ventrals. Lateral line much arched in front, descending to the sides posteriorly and then running straight. Caudal peduncle very narrow and compressed, from one-half to three-fifths the eye. Color in alcohol, silvery brown, dark on back and upper part of head, inclining to silver white below; filaments of spinous dorsal brownish black, blotches on the membranes above dark brown; ventrals, dark brownish, becoming darker distally, the outer portion blackish and with 5 dark blackish cross-bands; caudal with the outer portion with a dusky blotch; body marked with a number of large brownish spots or blotches on the sides, which are most distinct in the smaller examples; in all the specimens traces on sides behind gill-openings of a blackish, ocellated spot; caudal peduncle dark above and 2 dark spots at the base of the side in the 2 small examples. Here described from Misaki specimens; the largest collected by Professor Otaki measures $4\frac{11}{16}$ inches.

This species is rare on the coast of Japan, being found in rather deep water. We have two specimens, one from Tokyo, the other from Misaki.

(*nebulosus*, clouded.)

2. ZEUS Linnæus.

Zeus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 137 (*faber*; includes *Selene*, *Alectis*, *Zeus*, *Capros*).

Body ovate, much compressed, covered with small rudimentary scales. Head deeper than long, its profile steep. Mouth large, the upper jaw protractile; small teeth on jaws and vomer, none on palatines; preopercle unarmed; a series of spinous plates between ventrals

and anal; a series of bony plates along base of soft dorsal and anal, none along spinous dorsal; each plate armed with a pair of spines. Gill rakers short. Dorsal fins separate, near together; dorsal spines high and strong, some of them filamentous; anal spines 4; ventral rays 1, 7. Species rather few, fishes of remarkable appearance, all of the Old World, and all marked by a round black spot in the middle of the side.

(*Zéús*, Jupiter, the common John Dory having been called "*Piscis Jovii*.")

2. ZEUS JAPONICUS Cuvier and Valenciennes.

KANETATAKI (GONG RINGER); MATODAI (TARGET PERCH); MATOUWO (TARGET FISH).

Poisson à Miroir du Japon TILESUS, Krusensterbs' Reise, Atlas, about 1809, pl. LI, fig. 1; Japan.

Zeus japonicus CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 24 (on a Japanese drawing).—SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 123, pl. LXVI A.; Nagasaki (*Zeus faber japonicus* on plate).—BLEEKER, Verh. Bat. Gen., XXVI, 1857, Japan, p. 165.—NYSTROM, Svensk. Vet. Ak. Handl., 1887, p. 32; Nagasaki.—ISHIKAWA, Prel. Cat. 1897, p. 43; Tokyo, Boshu, Nagasaki.—STEINDACHNER, Reise Aurora, 1898, p. 211; Kobe.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 359; Tokyo.

Head $2\frac{1}{2}$; depth 2. D. X-23. A. IV-22, P. 14, V. I-7; scales 15-110-80. Body compressed, deep, and covered with small cycloid scales; no bucklers along the base of the spinous dorsal; along the base of the soft dorsal 7 bony bucklers, and all but the first with 2 short, strong, thorn-like spines, the inner the larger, compressed in front or above, directed backward, and the outer short, directed backward, outward, or slightly forward; 6 similar spines along the base of the anal on each side; along the abdominal ridge of the body, from the gill-opening, are a series of bony bucklers on each side, which are 6 before the ventrals and 3 more in the middle between each series, 8 between the latter and the anal; all the bucklers smooth without radiating ridges, and, except those along the soft dorsal and anal, with a single low, short spine directed backward. Head long, deep, greatly compressed, the upper profile convex; snout a little over 2 in the head; eye rather small, $2\frac{1}{4}$ in snout, $4\frac{1}{2}$ in head, and $2\frac{2}{5}$ in maxillary; anterior margin of eye nearer the tip of the snout than the posterior margin of the opercle; mouth large, deep, obliquely vertical, and with the mandible protruding; the maxillary broad distally, equal to three-fourths the eye, and extending posteriorly below the posterior nostril; lips very broad and thin; teeth small in the jaws and directed inward; nostrils close together and directly in front of the eye, the posterior very much larger than the anterior; 2 spines behind the eye and above its center, but the top of the head smooth and without any spines over the eyes; distal extremities of the articulators produced into 2 small

spines below; quadrate with a small spine below and behind the end of the maxillary; dentaries with 2 small spines at the symphysis below; edge of the preoperculum very long and oblique, the angle exceedingly obtuse and rounded; top of the head with 2 ridges between the eyes, the interorbital space two-thirds of the eye. Gill-opening very large, its lower margin three times that of the upper; gill rakers short, stumpy, and rounded, 5+8; no slit behind the fourth gill-arch.

Origin of spinous dorsal a little before the posterior margin of the operculum, the spines thick, strong, and elongated, terminating in long, thread-like filaments, and with their bases on each side, except the first and last two, with a single short spine projecting backward; the spinous dorsal high anteriorly; soft dorsal and anal gradually becoming higher posteriorly, the origin of the former behind that of the latter and the origin of the latter under the sixth dorsal spine; anal spines, except the first, with basal spines like those on the spinous dorsal; the first anal spine shorter than the second, which is the longest, and 3 in the head, and the others both still shorter, the last being the shortest; pectoral rather short, in advance of the spinous dorsal, but posterior to the posterior margin of the eye, rounded, and with its upper rays the longer; ventrals long, expanded, below the posterior part of the eye, the spine more than half the length of the fin and the innermost ray the shortest; ventrals $1\frac{2}{3}$ in head and reaching the base of the second anal spine; caudal with the margin convex and its length $1\frac{1}{4}$ in head. Lateral line very high in front, descending posteriorly to the sides and then running straight to the base of the caudal. Caudal peduncle compressed and about equal to the eye. Color in alcohol, brown, darker above; the spinous dorsal blackish brown, with indistinct darker spots; spinous anal with its lower borders and the ventral fins blackish; on the sides are about 9 indistinctly defined dark brownish bars running longitudinally, becoming reticulated somewhat as their course is interrupted by a large dark ocellus on the sides a short distance behind the opercles; the lateral ocellus marked with a smaller and darker ring inside; a dark spot at the base of the caudal; caudal dusky on the outer border. In small and young examples the spinous dorsal is more or less distinctly spotted, and there are traces of several bands across the caudal. Here described from a large specimen from Tokyo, which measures $12\frac{1}{4}$ inches.

This species is close to the John Dory of Europe (*Zeus faber* Linnaeus), differing mainly in the reduced number of bony plates. In color and habit the two species are very similar. The species is a common inhabitant of the bays of southern Japan, being taken in shallow water at almost every haul of the net.

Our specimens are from Tokyo, Misaki, Kobe, Hiroshima, Tsuruga, and Nagasaki.

3. CYTTOPSIS Gill.

Cyttopsis GILL, Proc. Ac. Nat. Sci. Phila., 1862, p. 126 (*roseus*); no description.

Body ovate, much compressed, with rudimentary scales; mouth rather small. the upper jaws extremely protractile; teeth small on jaws and vomer; preopercle entire; supraorbital ridges serrated; gill rakers very short; dorsal spines strong, not filamentous; ventral rays I, 7. Anal with two short spines more or less coalescent into a knife-like spine; knife-like spines on the median line between ventral fins and vent; spinous scales at base of soft dorsal and anal very small or obsolete, not shield-like, about one for each ray, none at base of spinous dorsal. Silvery fishes of the open seas, differing from *Zeus* in the absence of bony plates, and from *Cyttus* in having knife-like spines between ventrals and anal.

(*cyttus*, *κυττός* name of an unknown fish; *ὄψις*, appearance.)

3. CYTTOPSIS ITEA Jordan and Fowler, new species.

Head [$2\frac{1}{3}$];¹ depth [$2\frac{1}{4}$].¹ D. VII, 30; A. I, 30; P. 14; V. I, 9; scales 82. Body deep, compressed, and covered with small cycloid scales; a series of bony tubercles forming a ridge or keel, and covered with thin skin, along the bases of the soft dorsal and anal, and about equal in number to the fin rays; along the abdomen, from the gill-opening to the anus, a single series of bucklers, 7 in number, the last three being very large, and each with a single backwardly directed spine; region between and in front of the ventrals flattened and broad, anteriorly forming an angle just behind the gill-opening, which is furnished with several small denticles; all the bucklers are smooth and without striae. Head deep, the upper profile of the snout and space between the eyes and origin of the dorsal concave; eye very large and high in the head [2 in the snout, $1\frac{2}{3}$ in maxillary, and $3\frac{1}{2}$ in the head];¹ mouth large and deep, the maxillary broad distally, equal to one-half the eye; lips very broad and thin, the width of the upper equal to the width of the maxillary; teeth small, fine, and in broad bands in the jaws, those above very broad; nostrils close together, superior and directly in front of the eye, the anterior rounded and the posterior a slit twice as long; above the eyes a series of anteriorly directed small denticles on each side of the head: top of the head with some of the bones striated and covered with thin skin; dentaries with 2 small spines at the symphysis below; edge of the preopercle very long and oblique, the angle exceedingly obtuse and rounded; interorbital space concave and equal to one-half the eye. Gill-opening very large; branchiostegal rays, 7; gill rakers short and stumpy, 11 in number; no slit behind the fourth gill arch.

Origin of the spinous dorsal behind the gill-opening, the spines

¹The brackets indicate that such measurements, etc., as are given are not satisfactory, owing to the distorted snout of this specimen.

thick, short, strong, sharp, not terminating in filaments; third and fourth dorsal spines the longest and a little greater than the eye; first dorsal spine a little shorter than the fifth; anal with a single, compressed, short, tooth-like spine hooked backward and falling behind the origin of the soft dorsal; soft dorsal and anal similar, the anterior rays graduated to behind the middle of the fin, where it is highest; pectorals before the spinous dorsal, directly behind the gill-opening, and about equal to the eye; ventrals a trifle before pectorals, long, expanded, a little larger than the base of the soft dorsal, and with a very short spine at their bases; caudal damaged, short, about $1\frac{1}{2}$ times larger than the eye, and its base edged above and below with 3 short, sharp spines. Lateral line strongly arched in front and descending obliquely behind

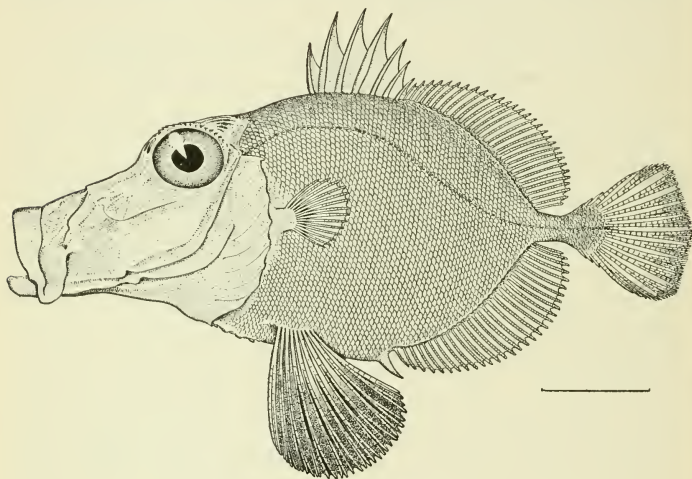


FIG. 1.—CYTTOPSIS ITEA.

at the caudal peduncle and then running straight to the base of the caudal. Caudal peduncle very narrow and somewhat thick and compressed, and a little less than the maxillary. Color in alcohol, brown above, silvery below, and all the fins except the ventrals plain; ventrals, with their outer halves of the membranes of the fin, brownish black, the rays being pale; on the outer parts of the membranes of the spinous dorsal some dark brownish black. [Total length, $6\frac{1}{2}$ inches.]¹

Here described from an example dredged by the U. S. Fish Commission steamer *Albatross* in Suruga Bay. It is numbered 50562 in the United States National Museum.

(*ιτέα*, a target.)

¹The brackets indicate that such measurements, etc., as are given are not satisfactory, owing to the distorted snout of this specimen.

Family II. ANTIGONIIDÆ.¹

BOARFISHES.

Body compressed and elevated, covered with small, ctenoid scales; sides of head scaly; preorbital and preopercle more or less serrate or armed; opercle small; gills normal; gill-membranes separate, free from isthmus; top of head bony; premaxillaries very protractile, the posterior process very long; mouth moderate, the lower jaw projecting; the teeth very small; lateral line not extending on caudal; dorsal fin long, the stout spines separated from the soft rays by a deep notch; dorsal spines not graduated; anal fin with three spines separated by a notch from the soft rays, the first spine longest; soft part of anal as long as soft dorsal; ventrals I, 5, the spine strong, inserted below pectorals; caudal fin rounded, on a moderate peduncle. Upper limb of the post-temporal widened at its distal end, which affords a very firm attachment; the lower limb short and thick. The supraclavicle long and slender, its posterior edge sharply serrate, the serrations standing out above the surface of the skin. Vertebrae in normal number, $10+13=23$ (*in Capros*). Species few, arranged in 2 genera, living in rather deep water. *Capros aper*, the Boarfish, superficially resembles the John Dory, *Zeus faber*, and is common on the coasts of southern Europe. This family, like the preceding, is of doubtful affinities. It is only remotely allied to the *Zeidæ*, and it has no relationship to the *Carangidæ* or other Scombroïd forms. *Antigonia* bears much superficial resemblance to the *Ephippidæ*, a resemblance doubtless arising from real affinity, as is shown by the form and attachment of the post-temporal. An extinct genus, *Proantigonia*, is said to connect *Antigonia* with *Capros*.

a. Lateral line complete. Body deeper than long, covered with rough scales.

b. Teeth slender, in jaws only; anal spines strong.....*Antigonia*, 4.

4. ANTIGONIA Lowe.

Antigonia LOWE, Proc. Zool. Soc. Lond., 1843, p. 85 (*capros*).

Caprophonus MÜLLER and TROSCHEL, Horæ Ichthyologicæ, III, 1845, p. 28 (*aurora*).

Hypsiniotus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 34, pl. XLII, fig. 2 (*rubescens*).

Body very deep, the depth much greater than the length of body, which is excessively compressed and covered with moderate-sized, firm, rough ctenoid scales; profile from nape to dorsal very steep and nearly straight. Surface of head above with rough bony striæ; preopercle and suborbital bones armed with slender antrorse spines;

¹We use the name *Antigoniidæ* in preference to *Capridæ*, as *Capridæ*, derived from *Capra*, is applied to the family of Goats. *Caproidæ* used by Gill seems hardly admissible.

mouth small, its cleft nearly vertical; premaxillary with a very long process, so that it is extremely protractile, perhaps less so than in *Capros*; lower jaw projecting; upper jaw somewhat protractile; maxillary broad, scaly; small, very slender teeth on jaws in one row, none on palate; chin rough; preopercle with rough striae, becoming antrorse spines below; cheeks deep, covered with rough scales; opercle short, scaly. Branchiostegals 6; gill-membranes separate, free from isthmus. Lateral line concurrent with the back. Fin spines stiff and strong. Dorsals united, the third spine stout and elevated, the sixth or last spine shortest, lower than the soft rays; the fin is thus distinctly notched. Soft dorsal and anal similar, long and low, none of the rays produced; anal spines 3, joined to the fin, the first longest. Base of dorsal and anal with a sheath of small, rough scales extending on the fin spines and slightly on the rays, not on the membranes; caudal peduncle short and deep, deeper than long; caudal short, squarely truncate; ventrals strong, of moderate length, at lowest point of ventral outline, well behind pectorals and directly below spinous dorsal, which is at its highest point of dorsal outline; ventral spine large, roughened anteriorly; pectorals moderate, not falcate. Species few, in waters of moderate depth.

(*Ἀντιγόρεια*, a city founded by Antigonus, the allusion not evident.)

- a. Dorsal rays VIII, 36; anal III, 33; snout very short *steindachneri*, 4.
 aa. Dorsal rays IX, 27; anal III, 26; snout more produced *rubescens*, 5.

4. *ANTIGONIA STEINDACHNERI* Jordan and Evermann, MS., new species.

HISHIDAI (DIAMOND TAI); YOKODAI (CROSSWISE TAI).

? *Antigonia capros* LOWE, Proc. Zool. Soc. London, 1843, p. 85; Madeira.

? *Caprophonus aurora* MÜLLER and TROSCHEL, Horæ Ichthyologicae, III, 1845, p. 28, pl. v, fig. 1; Barbados.

Antigonia capros STEINDACHNER and DÖDERLEIN, Fische Japans, III, 1884, p. 10, fig. 5; Tokyo, not of Lowe.—ISHIKAWA, Prel. Cat., 1897, p. 41; Tokyo.

Head 3; depth (greater with age and always more than the length of the body) exceeds the length of the body by half an eye diameter. D. VIII-36; A. III-33; P. I, 13; V. I, 5; scales 15-59-41. Body covered with rough etenoid scales, very deep and elevated, the back forming a sharp angle at an equal distance from the tip of the snout and the caudal peduncle in front, the apex forming the origin of the spinous dorsal; below the profile of the body is hemispherical. Head deep, the upper profile convex from the tip of the snout and then becoming concave over the eye in front; snout two-thirds the eye and equal to the interorbital space; eye large in the upper part of the head and $2\frac{1}{2}$ in its length; maxillary short, broad, the width equal to one-third the eye, the length 4 in the head, not extending to the lower margin and not reaching the anterior margin of the eye; preorbital

edge denticulate; mouth small, vertical, and with small teeth in each jaw; nostrils high, directly in front and level with the upper part of the eye, and close together; 5 rows of scales on the cheeks, and opercles with scales; each articular with 2 small denticles; head roughened and striated above and on the preoperculum, which is rounded and denticulate below. Gill-opening rounded, large, beginning about level with the middle of the eye; gill rakers about half as long as the gill-filaments and in moderate number; a small slit behind the fourth gill-arch.

First and second dorsal spines very short, the third the largest, equal to the eye and snout, then the others are graduated to the last, which is longer than the first and second; soft dorsal and soft anal similar, low and highest in front; origin of spinous anal below that of the spinous dorsal, graduated from the first spine, which is equal to the eye; pectorals in the lower third of the body, behind the gill-opening and with the upper longest rays three times the length of the inner; ventrals with a strong spine equal to the third dorsal spine, though the longest fin rays are still longer; caudal truncate with angular corners and a little longer than the third dorsal spine. Lateral line arched in front, then descending obliquely to the sides of the caudal peduncle and running straight to the base of the caudal. Color in alcohol pale brown, with traces of a dark streak from the beginning of the lateral line on the sides of the body backwards; membranes of ventral fins marked with brownish. Total length, $6\frac{1}{8}$ inches. Here described from a specimen from Kailua, island of Hawaii. Color in life salmon-pink, nape, back of head, and down ventrals deeper red, behind the bar from dorsal to ventral a paler shade; iris red; fins pale crimson, the caudal paler, with darker red tip.

This species is rather common in deep water about the Hawaiian Islands, specimens having been taken by Jordan and Evermann at Hilo, Kailua, and Honolulu. It has been once recorded from Japan and very well figured by Dr. Steindachner, who identified it with *Antigonia capros* of the West Indies and Madeira. The two species are closely related, but apparently distinct. *Antigonia rubescens* is a very different fish from *A. capros*, as is also the Australian *Antigonia mülleri*.

(Named for Dr. Franz Steindachner.)

5. ANTIGONIA RUBESCENS (Günther).

BENIHATATATE (RED FLAG RAISER).

Hypsinothys (?) SCHLEGEL, Fauna Japonica, 1847, p. 84, pl. XLII, fig. 2; Nagasaki.

Hypsinothys rubescens GÜNTHER, Cat. Fish., II, 1860, p. 63, copied.—GÜNTHER, Shore Fishes of the Challenger, 1880, p. 44; Manado, Ki Islands, Japan (confused with *A. steindachneri*).

Hypsinothys beuhatatate BLEEKER, Poiss. Commes du Japon, 1879, p. 9 (name only).

Head $2\frac{3}{4}$; depth (greater in young) less than half the length of the body by $\frac{3}{4}$ the diameter of the eye. D. IX-26 to 28; A. III-26; P. I-12; V. I-5; scales 14-60-40. Body covered with rough ctenoid scales, very deep and elevated, the back forming a sharp angle nearer the caudal peduncle than the tip of the snout, and the apex forming the origin of the spinous dorsal; below with the profile rounded and

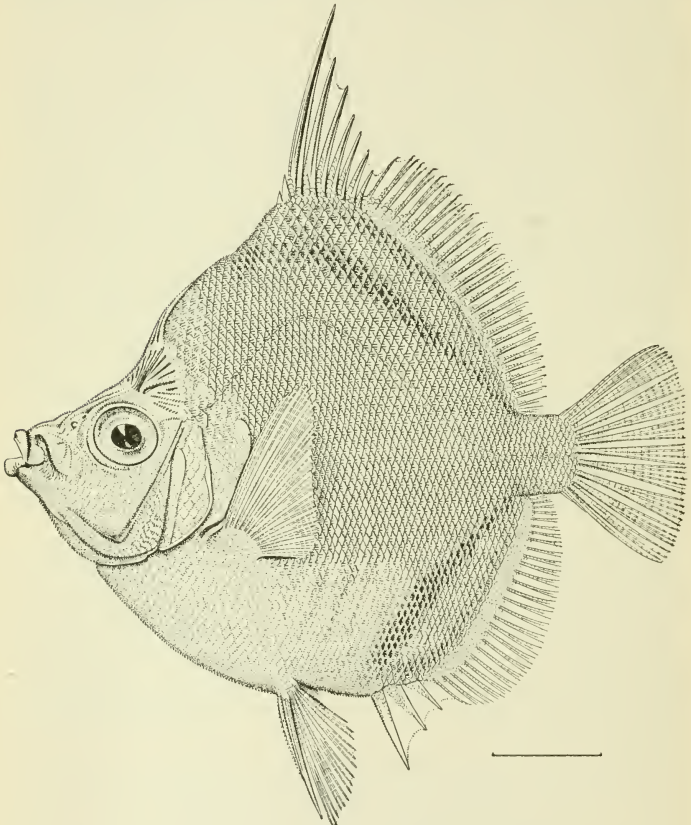


FIG. 2.—*ANTIGNONIA RUBESCENS*.

somewhat produced in the region of the spinous anal. Head deep, very concave above, the supra-occipital process forming a lump; snout equal to the eye, greater than the interorbital space; eye large, in the middle of the length of the head, in which it is contained 3 times; maxillary short, not very broad, not as far posterior as the anterior nostril, the width equal to one-third the eye, the length $4\frac{1}{3}$ in the head,

and extending below the lower margin of the eye; preorbital edge denticulate; mouth small, nearly vertical and with small teeth in each jaw; nostrils high, directly in front and level with the upper part of the eyes, and close together; 6 rows of scales on the cheeks, and opercles with scales; articulars with denticles; head roughened and striated above, and on operculum which is rounded and denticulate below. Gill-opening rounded, large, beginning about level with the eye; gill rakers short, mostly less than half the length of the gill-filaments and in moderate number; a small slit behind the fourth gill-arch.

First and second dorsal spines very short, the third the longest, equal to the head, then the others graduated to the last, which is larger than the first and second; soft dorsal and soft anal similar, low and highest in front; origin of anal behind that of the soft dorsal, graduated from the first spine, which is longer than the eye; pectorals in the lower third of the body behind the gill-opening and with the longest upper rays three times the length of the inner; ventrals with a strong spine $1\frac{1}{3}$ in the third dorsal spine, and the longest fin rays extending little beyond its tip; caudal truncate, with angular corners, and $1\frac{1}{2}$ in the third dorsal spine. Lateral line arched in front, then descending obliquely to the sides of the caudal peduncle and running straight to the base of the caudal. Color in alcohol pale brown, with a dark streak from some distance below the origin of the spinous dorsal to the caudal peduncle and a similar one from near the spinous anal to the base of the caudal peduncle below. Total length $6\frac{1}{2}$ inches. Here described from specimens dredged by the U. S. Fish Commission steamer *Albatross* at Stations 3717 and 3730, in Totomi Bay.

In young specimens the body is as deep as long without the caudal, and in an example $2\frac{1}{2}$ inches long from the Imperial Museum, taken at Misaki, the depth of the body exceeds its length.

This species is found in abundance in the deeper parts of the Japanese bays. Our numerous specimens were dredged by the U. S. Fish Commission steamer *Albatross* in Suruga Bay at Station 3707, at Station 3730, 34 fathoms, and at Station 3715 in 64 fathoms; in Totomi Bay, Stations 3734 and 3729 (34 fathoms). Another, taken at Misaki, was presented to us by Professor Mitsukuri. The fish is orange-scarlet in life, somewhat paler anteriorly. The species differs in many regards from *Antigonia capros* and *A. steindachneri*, notably in the much smaller number of dorsal and anal rays. Günther, Steindachner, and most recent writers have confounded the two, *Antigonia rubescens* having remained unknown since the time of Schlegel.

(*rubescens*, turning red.)

FAMILY III. PLATACIDÆ.

Body compressed, greatly elevated, the anterior profile steep, the caudal peduncle short. Scales small, ctenoid, densely covering the soft parts of the vertical fins; lateral line present, following the curve

of the back. Mouth small, terminal, horizontal; premaxillaries slightly protractile; maxillary short, without supplemental bone, jaws with bands of slender, pointed, movable, brush-like teeth; nostrils double; preopercle entire; gill-membranes broadly attached to the broad scaly isthmus, the openings restricted to sides; branchiostegals 6 or 7; pyloric caeca few; gill rakers very short; pseudobranchiae present. Dorsal fin continuous, 5 or 6 spines graduated and closely attached to the soft rays; soft dorsal and anal fins anteriorly high, their bases thickened by the scales; anal spines 3, graduated; caudal fin truncate; pectorals short, the rays all branched; ventrals thoracic, 1, 5, usually elongate but sometimes rudimentary; a large accessory scale as in the *Sparidae*; air bladder large. Vertebrae $10 + 14 = 24$. Post-temporal probably bifurcate and not solidly joined to the skull. A small group of fishes of the Asiatic seas related to the *Chatodontidae* but showing differences in the skeleton. We here include with the *Platacidae* the genus *Monodactylus* (= *Psettus* Cuvier), which has the general characters of the *Platacidae*, but the ventrals are rudimentary. The body is still deeper than in *Platax*.

5. PLATAX Cuvier.

Platax CUVIER, Règne Animal, 1st ed., I, 1817, p. 334 (*teira*).

Characters of the genus included above: the ventral fins well developed, the rays 1, 5.

(πλατύς, broad.)

- a. Dorsal with 28 to 34 soft rays; anal with 24 to 28; anterior profile rather evenly curved, without angle; 35 to 45 scales between first dorsal spine and lateral line; dorsal spines 5; teeth on the vomer in young individuals only... *teira*, 6.

6. PLATAX TEIRA (Forskål).

TSUBAMEUWO (SWALLOW FISH); TSUBAKURODAI (SWALLOW PERCH OR TAI).

Chatodon teira FORSKÅL, Descript. Animal, 1775, p. 60; Lohaje.

Chatodon teira CUVIER, Règne Animal, 1st ed., 1817, p. 354.—CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 226; Malabar.—CANTOR, Malayan Fish, 1850, p. 168.—GÜNTHER, Cat. Fish., II, 1860, p. 492; Moluccas, Borneo, Ceram, China, Pinang.—KNER, Novara Fische, 1866, p. 166.—KLUNZINGER, Fische Rothen Meeres, 1870, p. 791.—BLEEKER, Atlas, Ichth. Chaet., 1877-78, p. 73, pl. XVII, fig. 2; Sumatra, Batu-Nias, Pinang, Singapore, Bintang, Bangka, Cocos, Java, Madura, Bewan, Borneo, Celebes, Sumbawa, Timor, Ternate, Batjan, Ceram, Amboina, Goram, New Guinea.—ISHIKAWA, Prel. Cat., 1897, p. 41; Riukiu, Bonin Islands, Kagoshima (also No. 749, p. 43; Tokyo).

Chatodon daakar BONNATERRE, Ichth., p. 81, pl. xcv, pl. CCLXXXIX, 1788; Malabar (after *Chatodon teira* Bloch).

Chaetodon arthriticus BELL, Philos. Trans., 1793, p. 8, pl. vi; Sumatra.

Platax arthriticus, CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 229; Java.—GÜNTHER, Cat. Fish., II, 1860, p. 492; Amboyna, Pinang.

Platax albipunctatus RÜPPELL, Atlas N. A. Fische, 1828, p. 69, pl. XVIII, fig. 1; Red Sea.

- Platax gaimardi* CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 216; New Guinea.
- Platax leschenaldi* CUVIER and VALENCIENNES Hist. Poiss., VII, 1831, p. 223; Pondicherry, New Guinea.
- Platax punctulatus* CUVIER and VALENCIENNES Hist. Poiss., VII, 1831, p. 228; Timor.
- Platax vespertilio japonicus* SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 83, pl. XLIII; Nagasaki.
- Platax xanthops* BLEEKER, Verh. Bat. Gen., XXIII, Chaet., 1850, p. 28; Batavia, Java.—GÜNTHER, Cat. Fish., II, 1860, p. 490.
- Platax boersi* BLEEKER, Derde Bijdr. Celebes, III, 1852, p. 758; Macassar, Celebes.—GÜNTHER, Cat. Fish., II, 1860, p. 490.
- Platax anagou* MONTROUSIER, Fauna Woodlark, 1857, p. 170; Woodlark Island.
- Platax teira* JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 356; Formosa.

Head 3; depth greater than the length by the depth of the caudal peduncle. D. V-32; A. III-26; P. I-16; V. I-7; scales 28-75-46. Body very deep and compressed, very much elevated both above and below, and covered with small ctenoid scales which extend over the bases of the vertical fins where they become reduced in size and very numerous. Head deep, its anterior profile very steep; snout hardly projecting, straight; eyes high, $1\frac{1}{4}$ in snout, $3\frac{1}{5}$ in head and $1\frac{1}{5}$ in interorbital space; mouth small, the maxillary not reaching beyond the posterior nostril, its distal extremity as broad as the space between the anterior and posterior nostrils, which is two-fifths the eye; teeth in jaws slender, compressed, the edges notched or denticulate, and in bands; scales on the cheeks very small; nostrils about equal, the anterior pair level with the middle of the eye and the posterior pair above but directly in front of the margin of the eye; interorbital space convex. Origin of the dorsal in front of that of the anal, the spines graduated to the last which is the longest and joined to the soft dorsal; soft dorsal exceedingly long, the anterior rays from the first graduated to the last and higher than the depth of the body; anal spines graduated and joined to the soft anal which is similar to the soft dorsal except that it is lower; pectoral short, $1\frac{1}{3}$ in the head, below the gill-opening and behind the ventrals; ventrals under the posterior part of the eye, very long, extending posteriorly to the base of the caudal; caudal broad. Lateral line slightly arched to the base of the caudal. Caudal peduncle compressed, and $1\frac{1}{2}$ in the pectoral. Length without the caudal $5\frac{2}{3}$ inches. Here described from a young dried example from Miyako.

Notes on a specimen in the Imperial Museum are as follows:

Head 4; depth $1\frac{2}{3}$. D. IV-31 or 32; A. III-23; scales 73, small and largest on the middle of the sides. Profile nearly verticle, high at the nape. Preopercle entire; preorbital deep; eye 4 in head; maxillary $3\frac{1}{2}$ in head; teeth equal, brush-like and also on the vomer. Gill-membranes joined to the isthmus. Dorsal spines rudiments along the front of the dorsal; soft dorsal and anal higher than the length of the

head and scaly at base; pectoral short, $1\frac{1}{3}$ in the head; ventrals equal the head; caudal lunate and equal to the head. Color lost. Lateral line complete. Length $17\frac{3}{4}$ inches (450 mm.).

This, the adult form, is well figured by Bleeker, differing from the young chiefly in the lower fins.

This species, very abundant in the East Indies and along the southern coasts of China, is taken occasionally in the Kuro Shiwo off the coast of Japan. Besides a number of specimens from Formosa, we have a single one, obtained off Miyako in Rikuchu, in Northern Japan, presented to us by Mitonobu Irako, director of the museum at Morioka. In the Imperial Museum at Tokyo are specimens from Tokyo, Kago-shima, the Riukiu, and the Bonin Islands. In the Imperial University is one from Okinawa and one from Kezen.

According to Bleeker, this species is distinguished from *Platax vespertilio* (Bloch) by its smaller scales. In *Pl. vespertilio* there are 20 to 25 scales between the lateral line and the first dorsal spine. The dorsal rays in the latter are about V, 36.

(*orbicularis*, round.)

FAMILY IV. CHÆTODONTIDÆ.

BUTTERFLY-FISHES.

Body strongly compressed, elevated, suborbicular in outline, covered with moderate-sized or small scales, which are finely ciliated or nearly smooth; lateral line present, concurrent with the back, not extending on the caudal fin; mouth small, protractile, terminal; maxillary very short, irregular in form, divided in two by a longitudinal suture; upper part of skull solid, occipital crest strong; post-temporal firmly joined to the skull, its form really trifurcate, though appearing simple, the interspaces between the forks filled in by bone so that only a foramen is left; last bone of suborbital ring firmly joined to the preoperculum; teeth brush-like or setiform, often extremely long, in narrow bands in the jaws; no teeth on vomer or palatines; no canines, molars, or incisors; eyes lateral, of moderate size; branchiostegals 6 or 7; pseudobranchiæ very large; air bladder present. Gill-membranes more or less attached to the isthmus; gill rakers very small. Dorsal fin single, continuous, its rays sometimes filamentous, its soft part as well as the soft part of the anal densely covered with small scales; anal similar to the soft dorsal with 3 or 4 spines; ventrals thoracic, I, 5; caudal usually truncate. Vertebrae $10+14=24$, the anterior abbreviated; insertion of the ribs inferior; post-temporal usually reduced, and not bifurcate. Carnivorous fishes of the tropical seas, noted for their bright colors and great activity. The excessive quickness of sense and motion enable these fishes to maintain themselves in the struggle for existence in the close competition of the

coral reefs, notwithstanding their bright colors. The young are very different from the adult and pass through a stage termed *Tholichthys* in which the membranes are greatly developed, forming collars and sheaths about the head and neck. The Japanese name *Chochouwo*, or Butterfly-fish, like the Spanish name *Muriposa*, corresponds to our commonest English designation for these fishes.

Chatodontina:

- a. Preopercle unarmed; scales comparatively large (young with the *Tholichthys* form).
- b. Snout little if at all produced; dorsal spines 10 to 14, not graduated, some of the middle ones highest; anal spines 3.
- c. Dorsal spines, none of them elevated or filiform.
- d. Scales large, usually 35 to 50 in the lateral line.
 - e. Dorsal spines 12 to 14; teeth moderate; dorsal and anal with the base not strongly angulate *Chatodon*, 6.
 - ee. Dorsal spines 8 to 11; teeth very small; dorsal and anal strongly angulate at base so that the greater part of the base of each fin is vertical.
 - Coralion*, 7.
- dd. Scales rather small, about 60 in the lateral line; dorsal spines 10 or 12.
 - Microcauthus*, 8.
- ec. Dorsal fin with the fourth spine much elevated and filiform; scales moderate; forehead in the adult with bony projections *Heniochus*, 9.

Pomacanthina:

- aa. Preopercle armed at its angle with a very strong spine, which is sometimes grooved.
- f. Interopercle short and broad, armed with 1 to 4 strong spines; preopercle serrate or spinous; dorsal spines about 14, graduated, the last one longest; scales rather small; isthmus very narrow; vertical limb of preopercle simply serrate, with 10 to 30 small teeth; body oblong, rather robust.
 - Holocanthus*, 10.

6. CHÆTODON (Artedi) Linnæus.

CHOCHOUWO OR BUTTERFLY FISIES.

Chatodon ARTEDI, Genera, 1738, p. 51 (numerous species, the first one mentioned belonging to *Pomacanthus*; nonbinomial).

Tetragonopterus KLEIN, Historia Piscium, 1744, p. 37 (many species; *striatus*, etc.; nonbinomial).

Chatodon LINNÆUS, Systema Naturæ, 10th ed., 1758, p. 272 (includes all known *Chatodontidæ*).

Chatodon CUVIER, Règne Animal, 2d ed., 1829, p. 189 (*striatus*, *capistratus*; first restriction of the name to the present group).

Rabdophorus SWAINSON, Class'n Fishes, II, 1839, p. 21 (*ephippium*; scales on lower half in nearly horizontal series; scales about 45).

Citharædus KAUP, Wiegmann's Archiv., XXVI, Pt. I, 1860, p. 141 (*meyeri*; scales on lower half of body in horizontal series; scales small, about 50).

Linophora KAUP, Wiegmann's Archiv., 1860, XXVI, Pt. 1, 1860 (*auriga*; scales in series running downward and backward).

Sarothrodus GILL, Proc. Ac. Nat. Sci. Phila., 1862, p. 238 (*Chatodon* CUVIER, not ARTEDI; offered as a substitute for *Chatodon*, the latter name being transferred to *Pomacanthus*).

Tholichthys GÜNTHER, Ann. Mag. Nat. Hist., 1868, p. 457 (*osseus*; larval form).

- Tetragonopterus* BLEEKER, Rev. Famille Chetodontoides, 1877, p. 52 (*striatus*; scales below in horizontal series; spinous dorsal not more than half longer than soft).
- Chatodontops* BLEEKER, Rev. Famille Chetodontoides, 1877, p. 53 (scales on lower parts in ascending series).
- Hemichatodon* BLEEKER, Rev. Famille Chetodontoides, 1877, p. 53 (*capistratus*; scales below running downward and backward, forming an angle with those above).
- Lepidochatodon* BLEEKER, Rev. Famille Chetodontoides, 1877, p. 54 (*unimaculatus*; scales anteriorly much enlarged).
- Gomochatodon* BLEEKER, Rev. Famille Chetodontoides, 1877, p. 54 (*triangulum*; body very deep; the base of posterior half of soft dorsal and anal vertical).
- Oryzchatodon* BLEEKER, Atlas Ichth. Chet., 1877-78, p. 51 (*lincolatus*; scales very large, snout pointed).
- Chatodon* JORDAN and GILBERT, Synopsis, 1883, p. 614 (restriction to *capistratus*).
- Anisochatodon* KLUNZINGER, Fische des Rothen Meeres, 1884, p. 54 (*auriga*).

Body short, deep, very strongly compressed, especially above and behind; head small, compressed, almost everywhere scaly; mouth very small, terminal, the jaws provided with long, slender, flexible, bristle-like teeth; vomer sometimes with teeth; preoperculum entire or nearly so, without spine. Dorsal fin single, continuous, not notched, the spinous part longer than the soft part, of 12 or 13 spines, the spines not graduated, some of the middle ones being longer than the last; last rays of soft dorsal usually rapidly shortened, some of them occasionally filamentous; caudal peduncle short, the caudal fin fan-shaped; anal similar to soft dorsal, with 3 strong spines. Body covered with rather large ctenoid scales, somewhat irregular in their arrangement; the lateral line curved, high, parallel with the back. Gill-openings rather narrow, the membranes narrowly joined to the isthmus; branchiostegals 6. A very large genus of singular and beautiful fishes, abounding in the tropical seas, especially about volcanic rocks and coral reefs; most of them have the body crossed by transverse black bars. They are all very active, feeding on small animals.

(*χαίτη*, bristle; *ὀδόντις*, tooth.)

- a. LINOPIHORA: Rows of scales and dark stripes on anterior part of body sloping downward and forward, meeting posteriorly almost at a right angle with similar rows and stripes running downward and backward; a black ocular bar; dorsal rays XII, 23 to XIII, 25; anal rays III, 20 to 25; scales about 45.
- b. Dorsal with a soft ray in front produced in a filament; soft dorsal with a black ocellus.....*scitifer*, 7.
- bb. Dorsal without produced soft ray; no dorsal ocellus.....*rugabundus*, 8.
- aa. Rows of scales of lower part of body horizontal or nearly so; no lines meeting at a sharp angle; scales about 45.
- c. CHETODONTOPS: Rows of scales on lower parts in series ascending behind; a dark ocular bar, but no crossbar on body; dark streaks on sides, forked at their tips; no ocellus; ventrals yellow; D. XII, 23; A. III, 20.
collaris, 9.
- cc. Rows of scales nearly horizontal, not emphasized by longitudinal streaks.
- d. RABDOPHORUS: Ocular region with a distinct crossbar.
- e. Anal rays about III, 21; dorsal rays, XII, 25; soft dorsal with a black ocellus; sides with faint brown crossbars.....*modestus*, 10.

- cc.* Anal rays about III, 17; dorsal rays XII, 20; body nearly plain, its posterior part dark; no ocellus *Nippon*, 11.
dd. Ocular region without distinct dark cross-band; whole body black, mottled with golden; no ocellus; dorsal rays XIII, 22; anal rays III, 16. *Madalma*, 12.

7. CHÆTODON SETIFER Bloch.

Chatodon auriga FORSKÅL, Descr. Anim., 1775, p. 60; Djedda and Lobaia, Red Sea.—? CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 79; Massah.—? GÜNTHER, Cat. Fish., II, 1860, p. 7; Red Sea.—? KLUNZINGER, Fische des Rothen Meeres, 1870, p. 775.

Tetragonopterus auriga BLEEKER, Atlas Ichth., 1877-78, p. 47, pl. II, fig. 4; Sumatra, Java, Bewan, Cocos, Celebes, Flores, Timor, Ceram, Amboyna, etc.

Chatodon setifer BLOCH, Ichth., XII, 1797, p. 99, pl. ccccxvi, fig. 1; Coromandel.—CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 76; Bolabola.—GÜNTHER, Cat. Fish., II, 1860, p. 6; Ile de France, Amboina, China, Aneitum.—GÜNTHER, Fische Südsee, I, 1873, p. 36, pl. xxvi, fig. B.—ISHIKAWA, Prel. Cat., 1897, p. 53; Miyakoshima.

Chatodon auriga var. *setifer* DAY, Fish. India, I, 1875, p. 106, pl. xxvii, fig. 3; Nicobar Islands.

Pomacentrus filamentosus LACÉPÈDE, Hist. Poiss., IV, 1803, p. 511 (after *Ch. setifer* Bloch).

? ? *Chatodon nesogallicus* CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 63; Ile de France.—GÜNTHER, Cat. Fish., II, 1860, p. 10; Amboina.

Chatodon sebanus CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 57; Timor, Guam, Tongo, Ile de France, Java.

Chatodon lunaris GRONOW, Cat. Fish., Ed. Gray, 1854, p. 70; India.

Head $2\frac{2}{3}$ to 3; depth $1\frac{1}{2}$; D. XII or XIII, 23 to 26; A. III, 21; P. I, 15; V. I, 5; scales 44-15. Body short, deep, and strongly compressed; scales large on the sides, small on the head, soft dorsal and anal, and the base of the caudal. Head small; profile very steep; snout produced and pointed; eye large, equal to the snout, and 3 in the head; mouth shorter than the eye, the maxillary not extending backward as far as its anterior margin; nostrils small, in front of the eye; teeth curved and projecting in brush-like bands, in each jaw; interorbital space convexly flattened; gill-opening long, the membrane not united, but forming a fold across the isthmus; gill rakers few, very short and weak; dorsal spines robust and strong anteriorly, but shorter than the last, which are slender; soft dorsal forming an angle in the middle, the sixth and seventh spines produced beyond all the others into a point; first and second anal spines robust, the first half the length of the second, and the third slender and about equal to or a trifle longer than the second; soft anal with the middle rays very long and its edge rounded; pectorals low, as long as the ventrals and shorter than the head; ventrals pointed, the spine as long as the last dorsal spine; caudal truncate, the corners sharp. Lateral line very high and convex, concurrent with the margin of the dorsal fin, indistinct on the sides of the caudal peduncle. Caudal peduncle a trifle deeper than the length of the eye.

Color in spirits pale-brown, a little darker above; a dark-brown vertical band through the eye, equal to its width, and margined with white narrowly in front; 7 or 8 narrow, oblique, dark stripes sloping forward from the base of the dorsal till they meet on the sides; a series of 10 similar bands obliquely sloping in the reverse direction; edge of soft dorsal with a narrow dark-brown margin, below which and adjoining is a narrow white stripe; a large blackish-brown ocellus nearly as large as the eye in the upper corner of the soft dorsal behind the elongated rays; margin of soft anal pale with a narrow white line, above and adjoining is a narrow dark-brown line; about the middle of the caudal is a broad white bar, narrowly edged with brown. Here described from specimens from Okinawa, Riukiu. Length 4 inches.

This species is very abundant throughout the tropical Pacific Ocean from the Red Sea to the Hawaiian Islands. We have received 2 specimens from Nafa, in Okinawa, from Yonekichi Koneyama.

Bleeker identifies *Chaetodon setifer* with *Chaetodon auriga* without raising any question. But in *Chaetodon auriga* the black dorsal marking is not a spot, as in *setifer*, but becomes an "oblique cuniform blackish band from the origin of the soft dorsal to the posterior part of the anal." This certainly indicates specific distinction. *Chaetodon nesogalliens*, also included by Bleeker under *Ch. auriga*, has a broad band across the tail, the soft dorsal and the anal, with a white ring on the dorsal part. This is probably the young of *auriga*. The figures of Bleeker and Day represent *Chaetodon setifer*, not *Chaetodon auriga*. Cuvier and Valenciennes describe *Chaetodon auriga* as "a *Chaetodon setifer* without ocellus on the dorsal," a difference which is probably valid for distinction.

(*seta*, bristle; *fero*, to bear.)

8. CHÆTODON VAGABUNDUS Linnæus.

Chaetodon vagabundus LINNÆUS, Mus. Adolph Frid., 1754, p. 71; Syst. Nat., 10th ed., I, 1758, p. 276; India (after *Chaetodon restratus*, *fascia nigra transoculos*).—CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 50; Ile de France, Vanicolo, Amboina.—GÜNTHER, Cat. Fish., II, 1860, p. 25; Mauritius, Amboina.—GÜNTHER, Fische Südsee, I, 1873, p. 43.—DAY, Fish. India, I, 1875, p. 105, pl. XXVII, fig. 1; Andamans.

Tetragonopterus vagabundus BLEEKER, Atl. Ichth. Chet., 1877-78, p. 49, pl. XVI, fig. 1; Sumatra, Java, Celebes, Menado, Sumbawa, Timor, Bouro, Ceram, Amboina, etc.

? *Chaetodon pictus* FORSKÅL, Descr. Anim., 1775, p. 65; Moka, Red Sea.—GÜNTHER, Cat. Fish., IV, 1860, p. 24; Madras.—DAY, Fishes India, I, 1875, p. 105, pl. XXVI, fig. 2; Andamans.

? *Chaetodon decussatus* CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 54; Pondicherry.

Head $2\frac{3}{4}$; depth $1\frac{2}{5}$; D. XIII, 25; A. III, 20; P. I, 15; V. I, 5; scales about 5-15-12. Body short, deep, and strongly compressed;

scales very large on the sides and becoming minute on the soft dorsal, anal and the base of the caudal. Head small, the profile very steep; snout produced and pointed; eye large, equal to the snout and $2\frac{3}{4}$ in the head; mouth shorter than the eye; the maxillary not reaching below the posterior nostril; the nostrils very small and in front of the eye; teeth curved and projecting in brush-like bands, in each jaw; interorbital space slightly convex; gill-opening long; the membrane not united but forming a fold across the isthmus; gill rakers few, short and weak; dorsal spines robust, and strong in front, where they are shorter than the last, which are long and slender; soft dorsal with the middle rays the longest and rounded; first and second anal spines robust, the first a little over half the length of the second, and the third slender and about equal to the second; middle rays of soft anal produced and the edge of the fin rounded; pectorals as long as the head; ventrals long, nearly under the pectorals, and the first soft ray produced into a long point so that the fin is longer than the pectorals; upper caudal rays the longest; the edge of the fin obliquely straight. Lateral line high, very much arched, concurrent with the margin of the dorsal fin, and descending on the sides of the caudal peduncle to the tail. Caudal peduncle compressed till its depth is equal to the eye.

Color in spirits pale-brown, darker above; a dark-brown vertical band through the eye, equal to its width, and narrowly margined with white in front; 6 narrow oblique stripes sloping forward from the base of the dorsal till they meet on the sides a series of 11 similar bands, obliquely sloping in a reverse direction; edge of the soft dorsal with a narrow white margin; below this a deep-brown band broadest at the longest rays, and then below this white to the broad vertical dark-brown bar, which extends from the upper part of the anterior soft rays across the fin, the caudal peduncle, and down on the anal; margin of the anal white with a narrow brown band near the edge; base of the caudal with a deep-brown crescent. The above description from a specimen taken in Okinawa, Rinkiu, $2\frac{1}{6}$ inches long.

This species, very abundant in the East Indian Archipelago, and from the Red Sea to Polynesia, is known as a Japanese fish from a small specimen taken at Nafa, in Okinawa, by Yonekichi Koneyama, of Tokyo, and presented by him to the museum of Stanford University.

Dr. Bleeker unites *Cheetodon pictus* (= *decussatus*) with this species, stating that the black bands on dorsal and anal are sometimes widened, covering the whole fin. Our specimen is typical of *Cheetodon vagabundus*, agreeing with Day's figure.

(*vagabundus*, wandering.)

9. CHÆTODON COLLARIS Bloch.

CHOCHOUWO, BUTTERFLY-FISH; UCHIWADAI (FAN, PERCH).

Chatodon collaris BLOCH, Ichth., 1785, pl. CCXVI, fig. 1; Japan.—CUVIER and VALENCIENNES, Hist. Poiss., 1831, VII, p. 53, (copied, not *Chatodon* or *Tetraodonopterus collaris*, Bleeker, which is an East Indian species with dusky ventrals).

Chatodon aureus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 81, pl. XLII, fig. 1; Nagasaki (not *Chatodon aureus* Black).—RICHARDSON, Ichth. China, 1846, p. 246; Canton.—GÜNTHER, Cat. Fish., II, 1860, p. 29, copied.—ISHIKAWA, Prel. Cat., 1897, p. 52; Tokyo, Sagami Bay, Kagoshima.

Chatodon auripes JORDAN and SNYDER, Check List, 1900, p. 90 (substitute for *aureus*, preoccupied).

Head $3\frac{2}{5}$; depth $1\frac{3}{5}$; D. XII, 23; A. III, 20; P. I, 15; V. I, 5; scales about 45 (squamation damaged). Body short, deep, and strongly com-

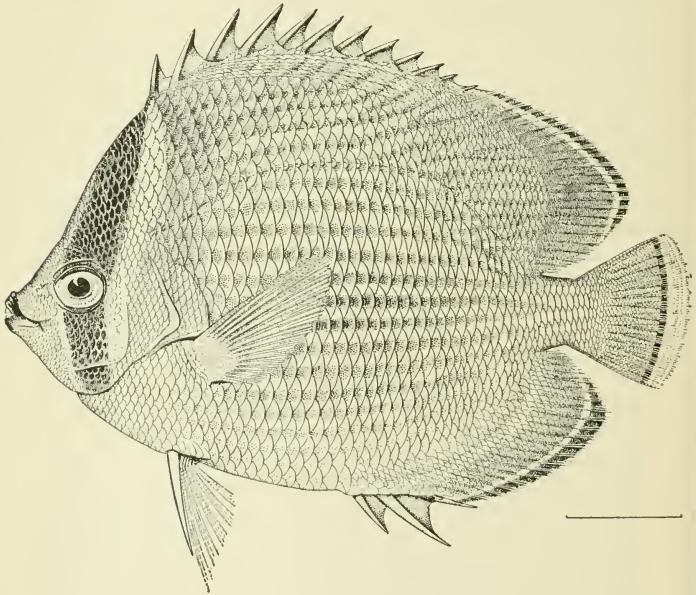


FIG. 3.—CHÆTODON COLLARIS.

pressed; scales large on the sides, small on the head, soft dorsal and anal, and the base of the caudal. Head small, the profile very steep; snout produced and pointed; eye a little greater than the snout and 3 in the head; mouth small, the maxillary extending to the first nostril; nostrils small, close together and in front of the eye; teeth curved and projecting in brush-like bands in each jaw; interorbital space convex; gill-opening long, the membrane a narrow free fold across

the isthmus; gill rakers few, short and weak; dorsal spines strong, the middle the longest and the posterior slender but longer than the first two; soft dorsal with a blunt angle behind the middle, due to the greater elongation of the rays; first anal spine short, and with the second, which is as long as the third, strong and thick, the third slender; anal fin with an angle behind the middle similar to soft dorsal; pectoral equal to the head, low in the body; ventral with the first ray long and pointed and shorter than the pectorals; caudal truncate, with pointed corners. Lateral line high, arched, and concurrent with the edge of the dorsal fin, descending on the caudal peduncle to the tail.

Color in spirits pale brown; a broad vertical band through the eye, blackish brown, margined narrowly in front below the eye and posteriorly along its whole length by a broad band of silvery white; ventral fins dark brown, the edges and a narrow band near the edges white; caudal broadly edged with white; ventral pale yellow in life; pectorals brown, edged with white; body on sides with about 18 pale olive longitudinal bands, the width of the pupil of the eye, the upper forking posteriorly. Total length $5\frac{1}{4}$ inches. The above description from a specimen from Ikune, in Satsuma.

This species is not rare in the warm waters about the headlands of southern Japan, from Tokyo southward. We have one example obtained by Professor Mitsukuri at Ikune, in Satsuma.

Its distribution to the southward is uncertain, as it has been confused with a closely related species, *Chaetodon prætextatus* Cantor (*Tetraodonopterus* or *Chaetodon collaris* of Bleeker, Günther, and Day), which is probably also *Chaetodon reticulatus* of Cuvier and Valenciennes.

In *Chaetodon prætextatus*, of which we have specimens from Formosa, the white stripe before the eye extends upward to the forehead, the dark streaks on the sides are more oblique and do not fork at the ends, and the ventrals are darker. Bloch's figure plainly represents *C. collaris*, the white stripe before the eye being especially clearly shown. His specimen is said to be from Japan.

The descriptions of *reticulatus* and *prætextatus* do not agree very well with our Formosan specimens. Perhaps we have three or more species of the type, perhaps one varying form. In any case *collaris* is the earliest name.

(*collaris*, having a collar.)

10. CHÆTODON MODESTUS Schlegel.

YAKKODAI (KNAVE TAI¹ OR PERCH).

Chaetodon modestus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 80, pl. xli, fig. 2; Nagasaki.—BLEEKER, Ichth. Fauna Japan, 1853, p. 8; Kamimoseki.—GÜNTHER, Cat. Fish., II, 1860, p. 10; Japan, China.—STEINDACHNER and DÖDERLEIN, Fische Japans, III, 1884, p. 23; Enoshima.—NYSTROM, Kong. Vet. Ak. Handl., 1887, p. 17; Nagasaki.

¹ Knaave used in the sense of a petty feudal retainer.

Chatodon ocellatus GROXOW, Cat. Fish., Ed. Gray, 1854, p. 68; Indian seas (not of Bloch).

Head 3; depth $1\frac{2}{3}$; D. XII, 25; A. III, 21; P. I, 15; V. I, 5; scales about 4-46-14. Body short, deep, and strongly compressed; scales large on the sides, small on the head, soft dorsal and anal and base of the caudal. Head small, the profile above oblique, and the snout produced and pointed; eye a little greater than the snout and $2\frac{2}{3}$ in the head; mouth small, the maxillary to the anterior nostril; nostrils small and close together, the first one-third the eye from its anterior margin; teeth curved and projecting in brush-like bands in each jaw; interorbital space convex; gill-opening long, the membrane a narrow free fold across the isthmus; dorsal spines about equal from the third, the first and second shorter and anteriorly more robust, stronger; soft dorsal with anterior rays longest and with an obtuse angle; anal spines robust, the second the longest; soft anal deep and rounded; pectoral shorter than the head; ventrals with the first ray long and pointed, extending to the base of the first anal spine; caudal truncate, with sharp edges. Lateral line high and concurrent with the margin of the dorsal fin, then descending on the base of the caudal peduncle to the base of the caudal. Caudal peduncle about equal to the eye.

Color in alcohol plain brown, darker above; sides with series of longitudinal dark lines not forking posteriorly; a blackish brown bar through the eye and equal in width to its diameter, margined behind with lighter; a blackish bar along the marginal portion of the soft dorsal and anal; a black ocellus on the upper part of the soft dorsal; a blackish bar at the base of the caudal; a brown bar across the base of the caudal peduncle; ventrals blackish brown; caudal and pectorals pale; tip of the snout blackish. Length $2\frac{5}{16}$ inches.

In smaller specimens there is a broad brownish vertical band on the anterior part of the back, separated by the white area behind the dark ocular bar; the light bar extends from before the dorsal vertically over the opercles to the breast; the dorsal ocellus is broadly bordered with white, extending downward in front of the band on the caudal peduncle as an indistinct light band; the posterior half of the caudal peduncle white; the profile is nearly straight from the tip of the snout to the origin of the dorsal.

In very young specimens the blackish brown band on the caudal peduncle extends along the base of the anal fin, and the bar at the base of the caudal disappears; the snout is convex, and the nuchal scales are large. Here described from a series of specimens from Misaki.

This species is not rare in rocky places along the southern coasts of Japan, and probably the corresponding parts of China. We have eight young examples from the rock pools about Misaki.

(*modestus*, modest.)

11. CHÆTODON NIPPON Döderlein.

SHIRAKODAI (SMALL WHITE PERCH).

Chaetodon nippon DÖDERLEIN, Fische Japans, II, 1883, p. 23, pl. IV, fig 2; Tokyo.

Head $3\frac{1}{3}$; depth $1\frac{2}{3}$; D. XIII, 20; A. III, 17; P. I, 14; V. I, 5; scales about 4-49-20. Body short, deep, strongly compressed; scales moderately large on the sides, small and numerous on the head, soft dorsal and anal, and the base of the caudal. Head small, the profile oblique and nearly straight above; the snout not much produced and pointed; eye greater than the snout, smaller than the interorbital space, and a trifle over 3 in the head; mouth small, the maxillary not reaching the anterior nostril; nostrils small, close together, and some little distance in advance of the eye; teeth curved and projecting in brush-like bands in each jaw; interorbital space convex; gill-opening long, the membrane obsolete; gill rakers short, weak, and not numerous; first and second dorsal spines short and the others about equal, the anterior ones more robust; highest rays of soft dorsal before the middle, and the marginal angle very obtuse; first and second anal spines robust, the third slender; soft anal high in the middle, and the margin of the fin rounded; pectoral low, not as far posteriorly as the ventrals and equal to the head without the snout; ventral spine long, the tip of the fin falling short of the anus by the length of the snout; caudal with the upper rays the longest and the edge obliquely straight. Lateral line high, concurrent with the margin of the dorsal fin, then descending on the base of the caudal peduncle to the base of the caudal. Caudal peduncle compressed, 3 in the head.

Color in alcohol dark brown, the spinous dorsal behind, the soft dorsal and the soft anal very dark brown, the two latter being edged narrowly with white; head dark above, the lips blackish; caudal whitish with its terminal portion broadly grayish. On the sides are traces of many indistinct, longitudinal bands. Length $5\frac{1}{8}$ inches. Here described from Misaki specimens.

This species, the most northern of its genus, has been found only about the peninsulas of Izu and Sagami. We have five specimens, one dredged by the U. S. Fish Commission steamer *Albatross* in Totomi Bay, near Hamamatsu from the rocks at Misaki, the others from the Tokio market, doubtless from Awa or Misaki.

(*Nippon*, or Nip-hon, the general name of the Japanese Empire, wrongly applied on European maps to the chief island, Hondo or Honshyu.)

12. CHÆTODON DÆDALMA Jordan and Fowler, new species.

Head $3\frac{1}{2}$ to $3\frac{3}{4}$; depth $1\frac{1}{8}$ to $1\frac{2}{3}$; D. XII or XIII, 22; A. III, 16; P. I, 14; V. I, 5; scales 6-46-18. Body very deep, short and strongly compressed; scales small, except on the sides, a little in front where they are much enlarged, and on the head, soft dorsal and anal, and caudal becoming very small. Head small, the profile above obliquely vertical, and the snout produced; eye smaller than the snout, $3\frac{1}{2}$ in head and equal to the interorbital space; mouth small, the maxillary reaching to the anterior nostril; nostrils close together and a little

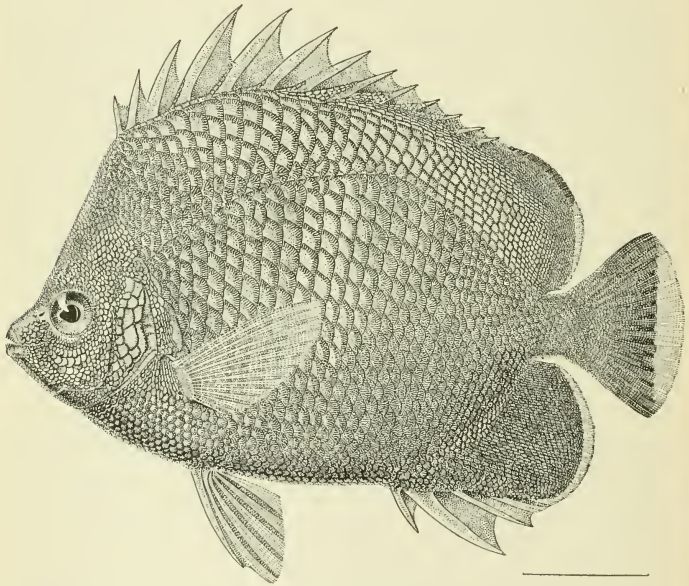


FIG. 4.—CHÆTODON DÆDALMA.

before the eye; teeth curved and projecting in brush-like bands in each jaw; interorbital space convex; gill-opening long, the membrane a narrow fold across and not united to the isthmus; gill rakers short and few; first dorsal spine short, the anterior ones longer than the others and more robust; soft dorsal with the rays in front the longest and the edge rounded; anal spines strong, the first the shortest and the second the longest; soft anal high and the edge rounded; pectoral low and about equal to the head; ventrals about equal to the pectorals, but not reaching the anus; caudal squarely truncate, the edge straight. Lateral line high, arched, concurrent with dorsal fin, and

indistinct on the caudal peduncle. Caudal peduncle compressed and $2\frac{1}{2}$ in head.

Color in alcohol deep blackish brown, the scales everywhere with their centers pale yellow and their edges broadly margined with blackish brown, forming a beautiful reticulated or netted pattern; edges of soft dorsal, anal, and caudal broadly margined with yellow; pectoral blackish with a large yellow spot on its middle; ventrals and space in front and between their bases deep blackish brown; along the sides longitudinal dark bands are formed, due to the course of the scales. Total length $6\frac{5}{8}$ inches. Here described from Okinawa specimens.

Type.—No. 7190, Leland Stanford Junior University Museum. Cotypes are in the U. S. National Museum.

We have received three specimens of this handsome species from Nafa, in Okinawa, two of them collected by Yonekichi Koneyama, the other from the Imperial University.

(*δαίδαλαμα*, a piece of art embroidery.)

7. CORADION Kaup.

Coradion KAUP, Wiegmann's Archiv, XXIV, 1860, pl. 1, p. 146 (*chrysozonus*).

This genus is allied to *Chatodon*, differing in its angular form, the base of most of the soft dorsal and anal being nearly vertical, in the very small teeth, and in the small number (8 to 11) of the dorsal spines, which are very strong; anal spines 3, very strong; scales moderate. Species few, of the East Indies.

(*κοράδιον*, *κορίδιον*, a little girl.)

13. CORADION DESMOTES Jordan and Fowler, new species.

Head $2\frac{3}{4}$; depth $1\frac{1}{3}$; D. II, 22; A. III, 18; P. I, 14; V. I, 5; scales 4-52-30. Body very short, deep, and compressed; scales small, except on the sides a little in front, where they are enlarged, and becoming very small on the head, soft dorsal, anal, and caudal. Head moderate, the profile above very concave and ascending steeply to the dorsal; eye equal to the snout (?) a trifle over 3 in the snout (?) and greater than the interorbital space; snout produced and pointed; mouth small, the maxillary reaching to below the anterior nostril; nostrils close together and a little before the eye; teeth projecting in brush-like bands in the jaws; interorbital space convex; gill-opening long, the membrane a narrow fold across the isthmus; gill rakers short, weak, and not especially numerous; spines anterior to the third dorsal spine short, the latter and the 3 or 4 succeeding, robust and longer than the others, so that the fin is high in front; the anterior 7 soft dorsal rays long, after which the others diminish so that a blunt angle is formed along the margin; anal spine strong, the first the shortest; soft anal deep in the front and middle, with its edge rounded; pectoral low, shorter than the head; ventrals longer than the pectorals, reaching beyond the origin of the anal; caudal square, the edge nearly

straight. Lateral line high, nearly concurrent with the margin of the dorsal, and forming a blunt angle a little posteriorly concurrent with that of the soft dorsal. Only a few pores on the caudal peduncle, which is compressed and equal to the first anal spine.

Color in alcohol pale brown, with a broad vertical band from the origin of the spinous dorsal through eye, about equal to it in width; a narrow band from the supraoccipital region to the tip of the snout; a broad brown band, a little less in width than the length of the pectoral,

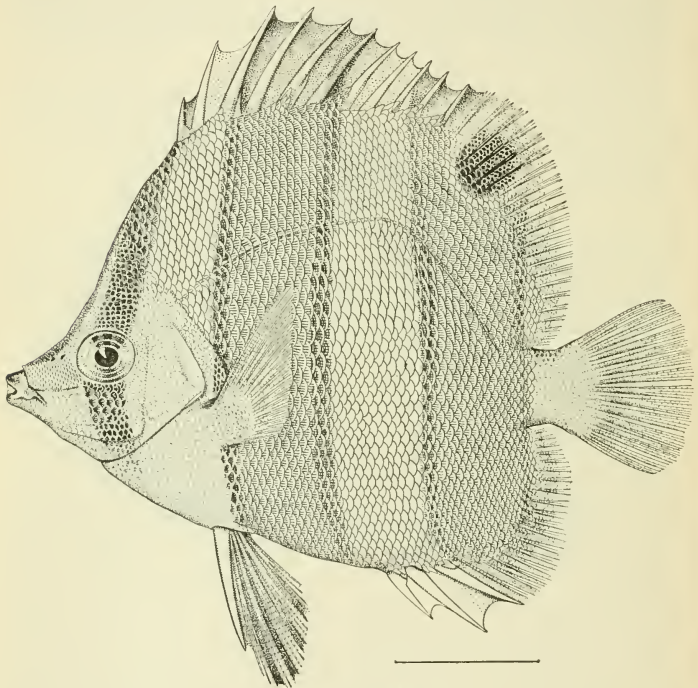


FIG. 5.—CORADION DESMOTES.

and margined narrowly with darker, from the spinous dorsal above to the belly, and a similar band of about equal width from soft dorsal to the soft anal; anterior part of soft dorsal with a black ocellus, the edge white, equal to the eye; caudal with the base brown and the outer half gray; ventrals blackish; a light band over caudal peduncle behind and the anterior part of the base of the caudal. Length, $4\frac{11}{16}$ inches. Described from a single fine specimen taken at Nagasaki.

Type.—No. 7192, Leland Stanford Junior University Museum.
(δεσμώτης, a prisoner, alluding to the narrow cross-bars.)

8. MICROCANTHUS Swainson.

Microcanthus SWAINSON, Class. Anim., II, 1839, p. 215 (*strigatus*).

This genus differs from *Chætodon* chiefly in the small scales, there being about 60 in the lateral line. The soft dorsal and anal are shorter than is usual in *Chætodon*, the fin formula of the typical species being D. XI, 17; A. III, 14. It is in fact doubtful whether the genus contains a second species, as the other species with small scales have the soft fins many-rayed and constitute Bleeker's genus *Hemitaurichthys* (type, *polylepis*), which is apparently a valid genus. In any case it has no close relation to *Microcanthus strigatus*.

(μικρός, small; ἄκανθα, spine.)

14. MICROCANTHUS STRIGATUS (Cuvier and Valenciennes).

KAGOKAKIDAI (CHAIR CARRIER PERCH); SHIMAYAKKODAI (STRIPED KNAVE PERCH.)

Chætodon strigatus (Laugsdorf) CUVIER and VALENCIENNES, Hist. Poiss., II, 1831, p. 25, pl. CXX; Japan.—SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 80, pl. XLI, fig. 1; Nagasaki.—BLEEKER, Verh. Bat. Gen., XXVI, 1857, Japan, p. 94; Nagasaki.—GÜNTHER, Cat. Fish., II, 1860, p. 34; China, Japan.—STEINDACHNER and DÖDERLEIN, Fische Japans, II, 1883, p. 23; Tokyo.—NYSTROM, Kong. Vet. Ak. Handl., 1887, p. 18; Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 52; Tokyo, Kagoshima.—STEINDACHNER, Reise Aurora, 1896, p. 202; Kobe.

Hemitaurichthys strigatus JORDAN and SNYDER, Check List, 1901, p. 90.

Head 3; depth 2; D. XI, 16; A. III, 16; P. I, 15; V. I, 5; scales 9-62-24. Body a little long, deep and compressed; scales more or less uniform on the trunk, small on the head and becoming very small on the soft dorsal, anal, and the base of the caudal. Head moderately compressed, the profile steeply convex above the eye; eye $2\frac{3}{4}$ in the head and greater than the interorbital space; snout nearly straight above, pointed and projecting; mouth moderately large, the maxillary extending to the anterior margin of the eye; nostrils small, directly in front of, and near the anterior margin of the eye; teeth in a brush-like series in the jaws; interorbital space flatly convex; gill-opening large, the membrane free from the isthmus; gill rakers rather short and in moderate number; dorsal spines strong, longest anteriorly, and graduated to the last, the first and second short; soft dorsal long in front, its margin rounded; second anal spine very large and strong; soft anal high in front and then decreasing to the last ray, the margin of the fin nearly straight; pectoral rather short, $1\frac{2}{3}$ in head; ventrals long and pointed, longer than the pectorals and reaching the origin of the anal; caudal with the lobes not produced much, pointed, and the margin concave. Lateral line arched, concurrent with the margin of the scaly sheath about the base of the spinous dorsal and the margin of the soft dorsal, and then running straight along the caudal peduncle to the base of the caudal. Caudal peduncle compressed and about equal to the ventral spines.

Color in alcohol pale, with 7 longitudinal slightly inclined broad blackish brown bands, the first along the middle of the spinous dorsal backward from the upper part of the third ray, then the others following below in a parallel manner; on the supraoccipital region of the head two bands running down between the eyes and uniting near the end of the snout; a dark bar from snout to eye; a dark spot on base of the pectoral; ventrals and caudal plain. Length $7\frac{2}{3}$ inches. In very small specimens the dark bars are very distinctly defined; there are 2 black spots on the dorsal, one at the base of the anterior spine and the other at the base of the anterior rays; on the anal the pectoral bar is continued out over the base of the anal spines on to the anterior rays, and there is also a black spot at the base of the posterior rays; a black band originates on the head above the eyes and forks at the pectoral, the anterior division going to the ventrals; a dark stripe runs across the chin from the maxillaries; outer portions of ventrals black. Here described from examples from Wakanoura.

This species is rather common about the headlands of southern Japan. Our numerous specimens are from Tokyo, Misaki, and Nagasaki. It is easily recognized by its 5 or 6 lengthwise stripes. It lacks altogether the ocular cross-band almost universal in *Chaetodon*. (*striqatus*, striped.)

9. HENIOCHUS Cuvier and Valenciennes.

Heniochus CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 92 (*macrolepidotus*).

Taurichthys CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 146 (*rarius*).

Diphrentes CANTOR, Malayan Fishes, 1850, p. 159 (*macrolepidotus*; substitute for *Heniochus*, on account of *Henioche*, a prior genus of *Lepidoptera*).

Body much compressed and elevated; the forehead in the adult often with bony projections; dorsal spines 11 to 13, the fourth greatly elevated and filiform; muzzle rather short; no teeth on the palate; no spine on the preopercle; scales moderate. East Indies; allied to *Chaetodon*, but well distinguished by the prolongation of the fourth dorsal spine.

(*ἡνίοχος*, a coachman, from the whip-like dorsal spine.)

15. HENIOCHUS MACROLEPIDOTUS (Linnæus).

HATATATEDAI (FLAG RAISER PERCH).

Chaetodon macrolepidotus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 274 (after Artedi, *Chaetodon lineis utriusque 2-nigris radio quarto dorsali longissimo setiformi*).—BLOCH, Ichth., 1788, p. 50, pl. cc, fig. 1; India.

Heniochus macrolepidotus CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 93.—SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 82, pl. XLIV, fig. 1; Nagasaki.—RICHARDSON, Ichth. China, 1846, p. 246; Canton.—GÜNTHER, Cat. Fish., II, 1860, p. 39; Ceylon, Amboyna, Port Essington.—DAY, Fish India, 1875, p. 110, pl. viii, fig. 3.—STEINDACHNER and DÜDERLEIN, Fische Japans, II, 1883, p. 24; Kochi.

Taurichthys macrolepidotus, BLEEKER, Atlas Ichth., Chact., 1877-78, p. 29, pl. v, fig. 1; Sumatra, Pinang, Celebes, Singapore, Java, Sumbawa, Luzon, New Guinea, etc.

Chatodon bifasciatus SHAW, Genl. Zool., IV, 1803, p. 342.

Hemiochus acuminatus CUVIER and VALENCIENNES, Hist. Poiss., VII, 1831, p. 98.

Chatodon mycteryzans GRONOW, Cat. Fish., Ed. Gray, 1854, p. 76.

Head 3; depth $1\frac{1}{3}$; D. XII, 23; A. III, 17; P. I, 16; V. I, 5; scales about 4-44-24. Body deep, compressed, the scales enlarged on the sides, small on the head, and becoming very small on the basal portion of the soft dorsal, anal, and the caudal. Head rather deep; eye $2\frac{3}{4}$ in the head and much larger than the interorbital space; snout nearly straight above, shorter than the eye, pointed and projecting; mouth rather small, the maxillary reaching nearly to the anterior nostril; nostrils close together in front of the eye; teeth small and fine in both jaws; interorbital space convex; gill-opening large, the rakers small and not numerous; gill-membrane very narrow and free from the isthmus; dorsal high in front, graduated to the fourth spine, which is very long, attenuated, and furnished with a filament, the total length exceeding the entire length of the fish; the fifth spine is longer than the third; middle of soft dorsal elevated; first anal spine short; soft anal with the anterior rays elevated into a sharp angle, then rapidly decreasing to the last, which are very short; pectoral low, moderate, about equal to the ventral spine; ventral under the pectoral very long, reaching to the middle of the base of the anal, and the tip of the ventral spine not extending to the origin of the anal; caudal moderate, the edge somewhat rounded. Lateral line high, very much arched, and extending down on the caudal peduncle. Caudal peduncle compressed, and equal to the eye.

Color in alcohol, dark above, head silvery white; the snout dark brownish and a dark brown band from one eye to the other across the forehead; a dark brown band from the first dorsal spines down the sides including the posterior part of the gill-opening, and the base of the pectoral to the belly, where it becomes broader and joining the one from the opposite side of the body; a white band of similar width behind the one just described, becoming very broad below, so that it extends over the first half of the anal fin; there is a second broad black band arising behind the tip of the fifth dorsal spine and extending obliquely across the body so as to include the posterior half of the anal fin; behind this the rest of the body is pale and silvery; the dark bands where they extend on the dorsal and anal fins, together with the entire ventral fins, are black. Length, $2\frac{3}{4}$ inches. In a very young specimen the profile of the body above and in front is more obliquely inclined, and the brown bands are broader, the posterior occupying all the rest of the back and caudal peduncle; the large nuchal scales are well developed. Here described from Wakanoura examples.

The young of this species are frequently taken in the Kuro Shiwo off the headlands in southern Japan. No adult examples have yet been recorded, and it is probable that the species does not breed in Japan. It is a handsome fish and may be known at all ages by the produced dorsal spine.

Our examples differ from the figures of Bleeker and Day in showing no black markings on the anterior part of the anal fin. Probably this coloration changes with age. If not, two distinct species may be con-founded under the name of *Heniochus macrolepidotus*. Our numer-ous specimens, the longest less than 3 inches, are from Wakanoura and Nagasaki.

(μακρολεπιδοτός, large-scaled.)

10. HOLACANTHUS Lacépède.

Holacanthus LACÉPÈDE, Hist. Nat. Poiss., IV, 1803, p. 525 (*tricolor*; scales large; caudal forked).

Genicanthus SWAINSON, Class. Fishes, II, 1839, p. 212 (*tamarckii*; scales large; caudal forked).

Centropyge KAUP, Wiegmann's Archiv., XXVI, 1876, p. 138 (*tibicen*; erroneously said to have four anal spines).

Chatodontoplus BLEEKER, Archiv. Neerl. Sci. Nat., XII, 1876, p. 26 (*mesoleucus*; isthmus broad).

Acanthochætodon BLEEKER, Archiv. Neerl. Sci. Nat., XII, 1876, p. 5 (*lepidolepis*; isthmus narrow; body elevated).

?*Angelichthys* JORDAN and EVERMANN, Check List, Fishes, 1896, p. 420 (*ciliaris*).

Body oblong or elevated, rather robust; scales rather small, rough-ish, often mixed with smaller ones. Vertical limb of preopercle with serræ, large or small; a strong spine at the angle of the preopercle, this usually grooved; interopercle short, armed with strong spines; dorsal spine with 12 to 15 strong spines, which are usually graduated, increasing in height to the last; soft dorsal moderate, with 17 to 20 rays, usually not ending in streamers. Coloration usually brilliant and well defined. Species numerous in all tropical seas, abounding about coral reefs. We include provisionally under *Holacanthus* the subgenera *Angelichthys*, *Chatodontoplus*, and *Acanthochætodon*. The following is an analysis of their principal characters:

- a. Ascending limb of preopercle with fine serrations only.
- b. Caudal rounded.
- c. Gill-membranes very broadly joined to the isthmus; body oblong-ovate; scales small *Chatodontoplus*.
- cc. Gill-membrane narrowly joined to the isthmus.
- d. Body oblong, not elevated; scales rather large..... *Centropyge*.
- dd. Body more or less elevated; scales small..... *Acanthochætodon*.
- bb. Caudal lunate, with produced lobes, scales large..... *Holacanthus*.
- aa. Ascending limb of preopercle with strong spines *Angelichthys*.

The three Japanese species belong to *Acanthochætodon* and *Centro-*

pyge.
(ὅλος, whole; ἄκανθα, spine.)

- a. ACANTHOCHÆTODON; scales very small; gill-membranes narrowly joined to the isthmus; caudal rounded; body deep.
- b. Body golden brown, with numerous blue or blackish stripes.
- c. Stripes on body relatively narrow, bright blue with darker edges, these extending horizontally on the soft dorsal fin *septentrionalis*, 16.
- cc. Stripes on body broader, blackish, these extending on the soft dorsal fin in the direction of the rays *ronin*, 17.
- aa. CENTROPYGE; scales large; isthmus narrow; body oblong; caudal rounded.
- d. Body blackish with an ovate white spot or crossband; scales rather large, rough *tibicen*, 18.

16. HOLACANTHUS SEPTENTRIONALIS Schlegel.

KINJAKUO (PURSE FISH).

Holocanthus septentrionalis SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 82, pl. XLIV; Nagasaki.—GÜNTHER, Cat. Fish., II, 1860, p. 52.—STEINDACHNER and DÖDERLEIN, Fische Japans, II, 1883, p. 24; Tokyo.—ISHIKAWA, Prel. Cat., 1897, p. 52; Tokyo.

Head $3\frac{3}{5}$; depth $1\frac{3}{5}$; D. I–XIII, 18; A. III, 19; P. I, 17; V. I, 5. Body deep, strongly compressed, and covered almost everywhere with small rough scales. Head deep, the profile steep above; snout not produced, and blunt; eye small, high, $1\frac{2}{5}$ in the snout, $3\frac{3}{5}$ in the head, and $1\frac{2}{5}$ in the interorbital space; profile of body from snout to ventrals evenly convex; mouth rather small, the maxillary nearly vertical and not extending to the posterior nostril; nostrils small, close together, and in front of the eye; lower jaw projecting a little; teeth slender, numerous, and in brush-like series in either jaw; interorbital space strongly convex; preopercle with finely denticulate edge, and armed with a strong, compressed spine, directed backward. Gill-opening large, the isthmus thick, and the membrane narrowly joined to it; gill rakers short and in moderate number. Dorsal and anal almost entirely covered with small rough scales, the spinous portions of the fins very rough; spinous dorsal highest posteriorly, gradually sloping up from the front; soft dorsal high in the front and with its margin rounded; anal graduated to the third spine, which is the longest, and the edge of the soft fin rounded behind; pectorals short, rounded, shorter than the ventrals and $1\frac{2}{5}$ in the head; ventrals with a strong roughened spine, not reaching the anus, and the tip of the longest ray not reaching the origin of the anal. Lateral line arched above so that it is concurrent with the margin of the dorsal and running on the caudal peduncle. Caudal peduncle compressed, and a little over 2 in the head.

Color in alcohol dark brown, the caudal white, very narrowly margined with brown; soft dorsal and anal a little darker than the body color, their margins very narrowly white, and then with very narrow blackish marginal stripes; on the sides are 7 or 8 narrow longitudinal bluish stripes margined with black, and on the dorsal and anal are several similar irregular narrow longitudinal stripes running the length

of the fins; pectorals with a bar across its basal portion, otherwise like the ventrals, plain. Length $6\frac{7}{8}$ inches. Here described from a specimen from Ikune, from Satsuma, in Kiusiu.

This handsome fish is rarely taken off the headlands of southern Japan. We have one fine specimen from Ikune in Satsuma, a province in the island of Kiusiu.

(*septentrionalis*, northern, most species of the genus being exclusively tropical.)

17. *HOLACANTHUS RONIN* Jordan and Fowler, new species.

Head $3\frac{1}{2}$; depth $1\frac{2}{3}$ to $1\frac{5}{6}$; D. I-XIII, 18 or 19; A. III, 17; P. 1, 17; V. I, 5. Body deep, strongly compressed, and covered almost

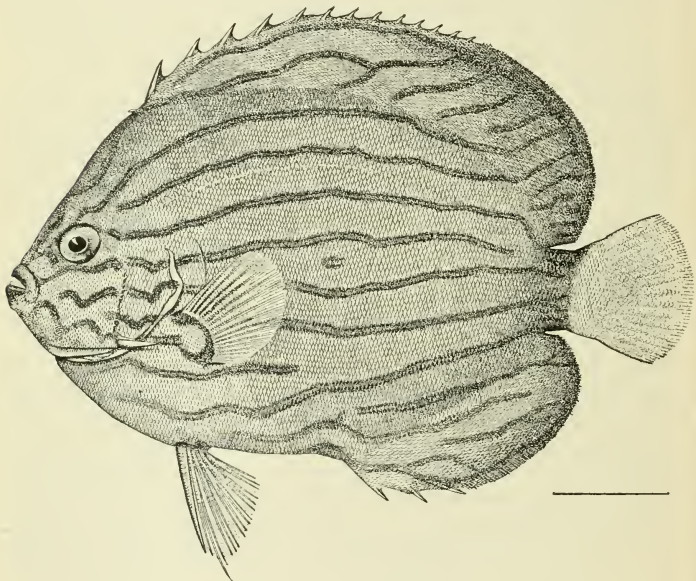


FIG. 6.—*HOLACANTHUS RONIN*.

everywhere with small, rough scales. Head deep; the profile above, very steep, and convex in the young, becoming more oblique and straight with age; eye small, high, $2\frac{1}{2}$ to 4 in the head, and 1 to $1\frac{2}{3}$ in the interorbital space; the eye a third longer than the snout in the young and $1\frac{2}{3}$ in the same in the adult; profile of body, convex from the tip of the snout to the ventrals; mouth small, the maxillary nearly vertical, and not extending beyond anterior nostril; nostrils small, close together, and in front of the eye; the lower

jaw projects, the snout being blunt; teeth slender, numerous, and in brush-like series in the jaws; preoperculum, with the edge finely denticulate, and armed below with a strong, compressed spine, directed backward; gill-opening large, the isthmus thick, and the membrane narrowly joined to it; gill rakers short and in moderate number; dorsal and anal almost entirely covered with small, rough scales, the spinous portions of the fins very rough; spinous dorsal higher posteriorly, gradually sloping up from the front; soft dorsal high, its edge rounded; anal graduated to the third spine which is the longest; soft anal high, the edge rounded behind; pectorals, low; ventral spine equal to third anal spine. Lateral line arched above, so that it is concurrent with the margin of the dorsal, and extending on the caudal peduncle. Caudal peduncle compressed, and a trifle over 2 in the head.

Color of the adult in spirits, dark brown, the caudal white; soft dorsal, anal, and caudal peduncle blackish, the edges of the former two fins narrowly margined with white; on the sides are 10 narrow longitudinal dark bands, margined rather broadly with blackish, some extending out on the soft dorsal and anal nearly parallel with the fin rays; on the anterior part of the dorsal and anal, several of the bars are nearly longitudinal; pectoral with a bar across its basal portion, otherwise, like the ventrals, plain. Length, $5\frac{1}{8}$ inches. In a small specimen, $2\frac{1}{8}$ inches long, the bands on the sides are 7 in number and broad, the soft dorsal and anal are very dark, almost uniform black, and there are two broad longitudinal bands on the spinous dorsal extending to the soft dorsal and two similar bands on the anal in front. In both specimens the bands are sometimes either interrupted or broken, the two sides not conforming. Here described from two examples, the larger from Misaki and the smaller from Wakanoura.

Numbered 7191, Leland Stanford Junior University Museum.

The specimen from Misaki was obtained from the Asakusa Aquarium in Tokio through the courtesy of Dr. Kishinouye.

The species is extremely close to *Holacanthus septentrionalis*, but differs in the color and direction of its dark stripes.

(*ronin*, a Japanese feudal waif, a retainer whose feudal lord is dead or degraded; an allusion to the habitat of the species distant from the Tropics, the original home of *Holacanthus*.)

18. *HOLACANTHUS TIBICEN* Cuvier and Valenciennes.

Holacanthus tibicen CUVIER and VALENCIENNES, Hist. Nat. Poiss., VII, 1831, p. 173 (locality unknown; specimen in the Leyden Museum).—GÜNTHER, Cat. Fish., II, 1861, p. 46 (copied).—BLEEKER, Atlas Ichth. Chaet., 1877-78, pl. VIII, fig. 4; Celebes, Flores, Ternate, Amboina, Ceram, Solor.

Holacanthus leucopleura BLEEKER, Solor, 1853, p. 79; Solor.—GÜNTHER, Cat. Fish., II, 1861, p. 46; Amboina.

Head $3\frac{3}{8}$; depth $1\frac{1}{6}$; D. XIV, 16; A. III, 17; P. I, 15; V. I, 5; scales 4-32-21. Body oblong, deep and compressed, and covered with striated, ctenoid scales. Head deep, the profile above very steep and convex; snout blunt and not produced; eye 3 in the head, greater than the snout and equal to the interorbital space; nostrils small, close together and directly in front of the eye; teeth slender, fine and in brush-like series in each jaw; profile of body convex below from tip of snout to the ventrals; mouth small, the teeth produced, and the maxillary below the posterior nostril; preorbital with several small denticles along its lower edge; preoperculum with its edge denticulate and produced below into a sharp spine directed backward, and equal to two-thirds the length of the ventral spine; lower margin of the gill-opening above the preopercular spine, denticulate; interorbital space strongly convex; gill-opening large, the membrane narrowly joined to the isthmus; gill rakers short and not numerous; spinous dorsal highest behind; soft dorsal higher behind the middle, with the angle rounded; soft anal highest behind and with a rounded angle; pectoral equal to ventral, the latter not reaching the anal; caudal convexly rounded. Lateral line high, arched and nearly concurrent with the dorsal outline. Caudal peduncle compressed, $1\frac{2}{3}$ in the pectoral.

Color in alcohol blackish brown, except a large, white, vertical, oblong blotch on the sides above and behind the shoulders, and the lower margin of the spinous and soft anal, which are also white. Total length $4\frac{5}{16}$ inches. Here described from an example from Okinawa.

This rare species is known to us from a fine specimen obtained at Nafa, Riukiu Islands, by Yonekichi Koneyama. It is well figured by Bleeker.

(*tibicen*, a flute-player, the allusion not explained.)

Family V. ZANCLIDÆ.

MOORISH IDOLS.

Body oblong, much compressed and elevated, covered with minute rough scales. Mouth small, with long, slender, brush-like teeth; no teeth on the palate; bones of top of head thick and solid, developing with age a conspicuous median horn on the forehead, wanting in the young. Preopercle unarmed. Dorsal single, with 7 spines, the third and succeeding spines prolonged into long filaments; interspinal bone projecting before dorsal. Anal similar to soft dorsal, long, with its anterior rays produced; a small antrorse spine before anal. Caudal peduncle unarmed, the fin lunate; pectorals short; ventrals pointed. Intestine long. Coracoid bones largely developed. Vertebrae reduced in number, $9+13=22$. Air bladder large. Branchiostegals 4; pyloric caeca 14. One species, widely distributed about rocky islands of the Pacific.

11. ZANCLUS Cuvier and Valenciennes.

Zanclus (Commerson Ms.) LACÉPÈDE, Hist. Nat. Poiss., IV, 1803, p. 473 (*cornutus*; non-binomial).

Pomacanthus pt. LACÉPÈDE, Hist. Nat. Poiss., IV, 1803, p. 517 (*canescens*, etc.).

Zanclus CUVIER and VALENCIENNES, Hist. Nat. Poiss., VII, 1831, p. 102 (*cornutus*).

Gonopterus GRONOW, Cat. Fish., Ed. Gray, 1854, p. 77 (*macreus*).

Gnathocentrum GUICHENOT, Ann. Maine et Loire, IX, 1866, p. 4 (*centrognahtum*; young).

Characters of the genus included above. It is possible that the generic name *Pomacanthus*, Lacépède, should be used for this genus, as the first species placed in that composite group by its author is the *Chætodon canescens* of Linnæus. The name *Zanclus* occurs still earlier in Lacépède's work, but not in binomial form. It is, however, for reason of priority adopted by Bleeker. If, however, the first species named be recognized as the type of the genus, a rule the present writers believe to be finally inevitable, we must substitute *Pomacanthus* for *Zanclus*.

(ζᾶγκλον, a sickle.)

19. ZANCLUS CANESCENS (Linnæus).

Chætodon canescens LINNÆUS, Syst. Nat., 10th ed., 1758, p. 272; Indies (after Artedi; young).

Pomacanthus canescens LACÉPÈDE, Hist. Nat. Poiss., IV, 1803, p. 517.

Zanclus canescens GÜNTHER, Cat., II, 1860, p. 493.—BLEEKER, Atlas Ichth., Chæt., 1877-78, p. 78, pl. v, fig. 3; Celebes, Amboina.

Chætodon cornutus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 273 (after Artedi; adult).—LACÉPÈDE, Hist. Nat. Poiss., IV, 1803, p. 473, pl. II, fig. 1.—JORDAN and EVERMANN, Fish N. and M. America, II, 1898, p. 1687.

Zanclus cornutus CUVIER and VALENCIENNES, Hist. Nat. Poiss., VII, 1831, p. 102, pl. CLXXVII.—BLEEKER, Atlas Ichth., Chæt., 1877-78, p. 77, pl. IV, figs. 1, 2; Sumatra, Java, Celebes, Ceram, New Guinea, Waigin, etc.

Zanclus centrognahtus CUVIER and VALENCIENNES, Hist. Nat. Poiss., VII, 1831, p. 528; near equator, 75° E.

Gonopterus macreus GRONOW, Cat. Fish., Ed. Gray, 1854, p. 77; India.

Chætodon nudus GRONOW, Cat. Fish., Ed. Gray, 1854, p. 76; Mari Indico.

Zanclus montrouzieri THOLLIÈRE, in Montrouzier, Fanna Woodlark Island, 1857, p. 168; Woodlark.

Head $2\frac{3}{5}$; depth about as great as length; eye $2\frac{1}{2}$ in snout. D. IX, 38; A. III, 33; snout $1\frac{1}{2}$ in head, greatly produced, the upper profile very concave; teeth slender, brush-like, very much projecting; anterior rays of dorsal and anal produced; first and second dorsal spines very short, the third greatly produced, ending in a long filament exceeding total length of fish; the longest soft ray about $1\frac{1}{2}$ in body; posterior dorsal rays short, vertical, or even inclined forward; pectoral some longer than snout, shorter than the ventrals.

Color in life, snout chiefly white, point of upper jaw black, followed by a large orange patch separated from the white by a narrow black

band; lower jaw mostly black; anterior part of body from first dorsal spine to ventrals black, this crossed by two narrow vertical blue lines, the first beginning at origin of ventrals, extending upward and forward, then backward just behind orbit, and ending on median line of back in front of dorsal fin; the second beginning on abdomen, crosses body at base of pectoral and ends at origin of dorsal fin; a third less distinct one extends upward and backward from eye; a broad whitish bar, nearly as broad as length of head, begins on anterior part of dorsal fin and crosses body somewhat obliquely backward, covering anterior portion of anal fin; posteriorly this bar is washed with yellow or orange, which gradually fades into the white of the anterior part; next comes a black bar one-half as wide, covering the bases of about 14 dorsal rays and widening out upon the anal so as to cover the greater part of about 24 rays; in the posterior part of this black band is a narrow white line; next a yellow or orange band covering all of the caudal peduncle and the posterior portions of the dorsal and anal fins; caudal fin black, a narrow white line at base; tip of caudal fin with a crescent-shaped border of white more or less washed with yellowish; pectorals pale; ventrals black. East Indies and islands of Polynesia; common and widely distributed; ranging east to the Hawaiian Islands and the offshore islands of Mexico, the young carried northward in the Kuro Shiwo to the coasts of Japan, where it is not rare in the rock pools of the headlands. Here described from a specimen from Misaki, $3\frac{1}{2}$ inches long.

Bleeker recognizes two species of this genus, the common form, *Zanclus cornutus*, with a preorbital spine in the adult, and a smaller one, *Zanclus canescens*, deeper in the body with a spine before the eye. All that we have seen are referable to *Zanclus cornutus*, but the other shows no tangible difference. *Canescens* is the older name.

(*canescens*, growing gray.)

Family VI. ACANTHURIDÆ.

SURGEON-FISHES.

Body oblong, compressed and usually elevated, covered with very small scales; lateral line continuous. Tail armed with one or more spines or bony plates. Eye lateral, high up; preorbital very narrow and deep. Nostrils double. Mouth small, low; each jaw with a single series of narrow incisor-like teeth; vomer and palatines toothless; premaxillaries somewhat movable but not protractile; maxillary short, closely united with the premaxillary; gill rakers obsolete; pseudo-branchiæ large; gills 4, a slit behind the fourth; gill-membranes attached to the isthmus, the openings thus restricted to the sides. A single dorsal fin, with strong spines, the spinous part of the fin shorter than the soft part; anal fin similar to soft dorsal; pectorals moder-

ate; ventral fins present, thoracic, I, 5. Pelvis bones long, narrow, curved, closely connected, evident through the skin, as in *Balistidæ*. Pyloric cæca rather few; air bladder large; intestinal canal long. Vertebrae $9 + 13 = 22$. Posterior suborbital bones in close contact with the preopercle; post-temporal immovably united with the skull, apparently simple, but really trifurcate with the interspaces filled in with bone, the foramen not passing through it; interneural bones with transversely expanded buckler-like subcutaneous plates, which intervene between the spines and limit their motion forward; epipleurals developed from the ribs. Herbivorous fishes of the tropical seas. These fishes undergo large changes with age as is the case with the *Chætodontidæ*, the young having often been described as distinct genera.

- a. Caudal armature developed as a movable antrorse, extremely sharp, knife-edged spine, erectile from a groove.
- b. Ventral rays I, 5; teeth fixed and strong; anal spines 3.
- c. Dorsal spines about 9 *Teuthis*, 12.
- cc. Dorsal spines 4 or 5; soft dorsal elevated *Zebrasoma*, 13.
- aa. Caudal armature developed as immovable tubercles or lamina.
 - d. Ventral rays I, 5; anal spines 3; dorsal spines usually 8; caudal plates 3 or 4, broad, rugose, with a central nonserrated spine *Xesurus*, 14.
 - dd. Ventral rays I, 3; dorsal spines 4 to 6; anal spines 2; caudal plates 1 or 2, absent in the young; adult usually with a bony frontal prominence. *Acanthurus*, 15.

12. TEUTHIS Linnæus.

Rhomboides KLEIN, *Historia Piscum*, 1740 (nonbinomial).

Hepatus GRONOW, *Zoöphyl.*, 1765 (*hepatus*; nonbinomial).

Teuthis LINNÆUS, *Syst. Nat.*, 12th ed., 1766, p. 507 (*hepatus*; *javus*; after *Hepatus*, GRONOW).

Harparus (FORSTER) GMELIN, *Syst. Nat.*, I, 1788, p. 1269 (species "cauda utriusque spina vel squama ossea falcata munita").

Aspisurus LACÉPÈDE, *Hist. Nat. Poiss.*, IV, 1802, p. 556 (*sohar*).

Teuthis CUVIER, *Tab. El. Hist. Nat.*, 1798, p. 371.

Teutis CUVIER, *Règne Animal*, 1st ed., II, 1817, p. 330 (restricted to *Les Acanthures*; allies of *Teuthis hepatus*).

Teuthys SWAINSON, altered orthography.

Acronurus GÜNTHER, *Cat. Fish.*, III, 1861, p. 345 (*orbicularis*; young fishes apparently scaleless).

Rhomboides (Klein) DAY, *Fishes India*, I, 1876, p. 202.

Acanthurus, of authors generally, not of Forskål as here understood.

This genus includes those *Acanthuridæ* which have the tail armed with a sharp, antrorse, lancet-like, movable spine; strong, fixed, incisor teeth; ventral rays I, 5, and about 9 spines in the dorsal fin. The numerous species are found in all tropical seas; herbivorous fishes, living about coral reefs; the adult protected by the murderous caudal spine, which grows larger with age.

(*τευθίς*, the Squid, *Loligo*; substituted by Linnæus for Gronow's name, *Hepatus*, for no evident reason.)

- a. Caudal spine small; body light gray, with about six cross bars, narrower than the interspaces; end of caudal peduncle with two black spots; dorsal rays about IX, 23; anal III, 21.....*triolestegus*, 20.
- aa. Caudal spine strong; body dark brown, uniform, or with faint bluish streaks; dorsal rays about IX, 26; anal III, 24.
- b. Axil of dorsal and anal fins without black spot; body and fins with faint streaks.....*argenteus*, 21.
- bb. Axil of dorsal and anal fins with a jet black spot; lips black; body and fins almost plain dark brown.....*bipunctatus*, 22.

20. TEUTHIS TRIOSTEGUS (Linnæus).

SHIMADAI: (STRIPED PERCH.)

Chatodon trioestegus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 274; India.

Acanthurus trioestegus CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 197.—GÜNTHER, Cat. Fish., III, 1861, p. 327; Amboina, Celebes, Aneitum, Australia, Malayan Archipelago.—ISHIKAWA, Prel. Cat., 1897, p. 34; Ogasahara (Bonin Islands).

Chatodon zebra LACÉPÈDE, Hist. Nat. Poiss., III, 1802, p. 25, fig. 3; no locality.

Acanthurus zebra LACÉPÈDE, Hist. Nat. Poiss., IV, 1803, p. 546, pl. vi, fig. 3; no locality.

Chatodon couagga LACÉPÈDE, Hist. Nat. Poiss., IV, 1802, p. 727; no locality.

Teuthis australis GRAY, in King's Narr. Survey Coast of Australia, II, 1826, p. 435; west coast of Australia.

Acanthurus hirundo BENNETT, Ceylon Fishes, 1830, p. 11, pl. xi; Ceylon.

Acanthurus subarnatus BENNETT, Whaling Voyage, II, 1840, p. 278; Society Islands.

Harpurus fasciatus FORSTER, Desc. Anim., Ed. Licht., 1844, p. 216.

Head $3\frac{2}{5}$ to 4; depth $1\frac{5}{6}$ to 2; eye $2\frac{1}{2}$ in snout. D. IX or X—22 or 23; A. III—20 to 22. Body ovate, anterior profile gently curved, most convex over eyes; snout somewhat produced, concave above. Dorsal fin moderate, anterior spines more or less concealed in the skin, the longest spines about equal to the snout, the soft rays equal; first anal spine very short, the third longest, about equal to the longest dorsal spines; soft portion of anal about as high as the third anal spine; caudal slightly lunate, the lobes but little produced; pectorals about as long as head; ventrals as long as snout, including the eye. Color in life dark greenish or slaty above with yellowish cloudings; chin, belly, throat, and a narrow strip along base of anal white; vertical fins dusky; anal with a narrow white margin; pectorals plain; ventrals white on under surface; sides with 5 black bars, each wider than the eye, the first, beginning just in front of the branchiostegals, extends upward and backward across cheek through eye and to median line of back, where it meets its fellow from the other side, is narrower than the eye; the second begins at front of dorsal fin and extends downward to base of pectoral, from which point it is continued downward in a narrower line beginning on base of pectoral and ending just above base of ventral; the third begins near base of sixth dorsal spine and extends across side to belly at a point midway between anus and begin-

ning of anal fin; the fourth begins on base of first dorsal ray and extends to first anal ray; the fifth begins at base of seventh dorsal ray and extends across side to base of fifth anal ray; a narrow, faint brown bar from the beginning of the gill-opening below running low along the sides of the abdomen to the last vertical stripe; a black spot on upper and lower sides of caudal peduncle. Length $8\frac{3}{4}$ inches. Here described from specimens from Okinawa.

Pacific Ocean; very abundant about rocky islands from New Zealand and Australia to the rocky headlands of Japan. Our specimens from Okinawa (adult) and Misaki (young). The Polynesian species, extending to the Revillagigedo Islands, and described as *Teuthis triostegus* by Jordan and Evermann, is a distinct form, *Teuthis sandwichensis* (Streets).

(trioestegus, τρεῖς, three; στῆγω, to cover.)

21. TEUTHIS ARGENTEUS (Quoy and Gaimard).

Acanthurus argenteus QUOY and GAIMARD, Voy. Uranie, Zool., 1824, p. 372, pl. XLIII, fig. 2; Sandwich Islands, Mariannes.—CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 239.

Acronurus argenteus GÜNTHER, Cat. Fish., III, 1861, p. 346; Ascension Island.

?*Acanthurus fuliginosus* LESSON, Voyage Coquille, 1824, p. 149, pl. XXVII, fig. 2.

?*Acanthurus nautoides* CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 204; Onalan (Longest dorsal spine $3\frac{1}{2}$ in depth of body).—GÜNTHER, Cat. Fish., III, 1861, p. 331; Amboyda, Pinang, Fiji.—STEINDACHNER and DÖDERLEIN, Fische Japans, III, 1884, p. 37; Oshima (near Misaki).

Acanthurus annularis CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 209; Ile de France.

Acanthurus bluchi CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 209; Ile de France, Seychelles.—GÜNTHER, Fische Sudsee, I, 1873, p. 109, pl. LXIX, fig. 6; Caroline Islands, Seychelles, Society Islands, Samoan Islands, Palm Island, Kingsmill Islands.

Acanthurus xanthopterus CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 215; Seychelles.—CANTOR, Cat. Malayan Fish., 1850, p. 209, pl. IV; Malayan Archipelago.

?*Acanthurus lamarrii* CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 236; Ile de France (Anal rays III, 23.)

Acanthurus melanurus CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 240; Pondicherry.

Acronurus melanurus GÜNTHER, Cat. Fish., III, 1861, p. 346; Borneo.

Head $3\frac{1}{3}$; depth $1\frac{2}{3}$. D. IX, 26; A. III, 24; snout $1\frac{2}{3}$ in head; eye $3\frac{1}{3}$; pectoral equal to head; caudal one-fifth longer than head; longest dorsal spine equaling longest soft ray, $1\frac{1}{2}$ in head; ventral long, $1\frac{1}{2}$ in head. Body deep and compressed, the anterior profile steep, convex before eye; caudal lunate, the upper ray one-third longer than middle one. Body slaty brown, mottled with gray, but without bands; dorsal with a bluish gray streak at base, then a bronze one, forking on soft dorsal, inclosing a bluish gray streak; 5 gray streaks and 4 bronze ones on dorsal more or less distinct, especially in young; anal with 5 bluish gray and 5 bronze streaks more oblique than those on the dorsal, and

hence not continuous the whole length of fin; caudal peduncle black, a whitish yellow cross-band behind spine, faint in adult, the anterior margin vertical, the posterior concave; rest of caudal black; pectoral yellowish; ventrals dusky, the spine black. All the marks very faint and often fading in alcohol. Adult with the pectoral quite yellow; pale band at base of caudal, growing faint with age; a blue streak along base of dorsal. Length $4\frac{1}{8}$ inches. Rocky shores throughout the Indian region from the Red Sea to the Hawaiian Islands, everywhere very common, occasionally northward to the projecting headlands of Japan. We have one adult example, described above, from Nafa, in Okinawa. Another adult is from Umesawa, and a young specimen from tide pools at Misaki. The species is very close to *Teuthis crestonis* of the west coast of Misaki, and to *Teuthis bahianus* of the West Indies. Much of the synonymy of this species is very hypothetical. The oldest name applying to the species beyond a doubt is that of *Acanthurus annularis*. But there is scarcely any doubt as to *A. matoides*, and *A. annularis* is apparently the young of the same species. The Hawaiian fish should therefore stand as *Teuthis argenteus*. The Japanese form is apparently not different.

(*argenteus*, silvery.)

22. TEUTHIS BIPUNCTATUS (Günther).

?? *Acanthurus nigroris* CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 208; Sandwich Islands.

Acanthurus bipunctatus GÜNTHER, Cat. Fish., III, 1861, p. 331; China, Fiji.

Teuthis bipunctatus JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 358; Formosa.

Acanthurus nigros GÜNTHER, Cat. Fish., III, 1861, p. 332; New Hebrides.—ISHIKAWA, Prél. Cat., 1897, p. 34; Miyakoshima.

Head $3\frac{1}{3}$; depth 2. D. IX-25; A. III-23, P. I-16; V. I-5. Body long, compressed, and covered with very small ctenoid scales. Head long, convex above the eyes; eyes high, $2\frac{2}{3}$ in snout, 4 in head, and $1\frac{1}{2}$ in interorbital space; snout slightly produced, $1\frac{1}{2}$ in pectoral, and nearly straight above; head equal to the pectoral; interorbital space strongly convex above; nostrils directly in front of the eye, the anterior rounded and the posterior a small slit. Gill-opening equal to the snout; gill rakers very small, short, and few. Origin of the dorsal over that of the pectoral, the spinous part graduated to the middle and then about equal to the rest of the fin, which ends in a point; the spinous anal graduated to the third spine, which is the longest, and not as high as the highest soft rays; soft anal oblong, ending in a point posteriorly; pectoral longer than head; ventrals equal to the snout with the eye; caudal lunate, the upper lobes pointed. Caudal peduncle compressed, rather deep, and $2\frac{1}{2}$ in the head. Caudal spine sharp, depressable in a groove, and about 2 in the snout. Lateral line concurrent with the back to the caudal spine. Color in alcohol dark chocolate brown, and with the edge of the caudal narrowly margined with white, a black

spot at the base of the last soft dorsal rays on the caudal peduncle above and a similar one at the base of the last anal rays below; edge of the groove of the caudal spine black; lips black, outer portion of the ventral rays blackish. Length $6\frac{3}{16}$ inches. Here described from a specimen from Kotosho, Formosa.

This species is found in the Rinkiu Islands, a specimen being in the Imperial Museum from Miyakoshima. We have also two specimens from Kotosho, Formosa, and of this or some closely related species from Hawaii. The species may be known by the black blotch in the axils of the dorsal and anal, in connection with the uniform blackish coloration. In the description of *Acanthurus nigroris* no mention is made of this very conspicuous character. It is not likely therefore that Valenciennes's fish belonged to the present species.

(*bipunctatus*, two-spotted.)

13. ZEBRASOMA Swainson.

Zebрасoma SWAINSON, Nat. Hist. Anim., II, 1839, p. 256 (*edijer*).

Scopus KNER, Novara Fische, 1865, p. 212 (*scopus*).

This genus differs from *Teuthis* in the short spinous dorsal of 4 or 5 graduated spines; soft dorsal high; snout short, projecting at an angle. Asiatic seas.

(zebra, $\sigma\tilde{\omega}\mu\alpha$, body, from the cross-bands of the typical species.)

23. ZEBRASOMA FLAVESCENS (Bennett).

Acanthurus flavescens BENNETT, Zool. Journal, IV, 1828, p. 40 (yellow form).

Acanthurus flavescens GÜNTHER, Fische Sudsee, I, 1873, p. 116, pl. LXXVI; Tahiti (probably not of Bennett).

Acanthurus rhombens KITTLITZ, Mus. Senckenberg, I, 1834, p. 196, pl. XIII, fig. 16.

Acanthurus scopus CUVIER and VALENCIENNES, Hist. Poiss., X, 1835, p. 245, pl. CCXC; Ile de France, Ulea.—BLEEKER, Natur. Tydschr. Nederl. Ind., 1851, p. 348.—GUICHENOT, Sagra Hist. Cuba, 1851, p. 122 (Cuba by error).—GÜNTHER, Cat. Fish, III, 1861, p. 342; Ceram, Sandwich Islands, Aneitum.

Acanthurus altivelis CUVIER and VALENCIENNES, Hist. Poiss., X, 1835, p. 249; Ile de France.

Head $3\frac{1}{4}$; depth $1\frac{2}{3}$. D. V-24; A. III, 19; P. I-14; V. I, 5. Body deep, compressed, and covered with minute rough scales. Head long, oblique; snout much produced, very concave above; eye high, $3\frac{1}{2}$ in the snout, $4\frac{1}{2}$ in the head, and $1\frac{2}{3}$ in the interorbital space; nostrils small, close together, directly in front and below the middle of the eye; interorbital space flat, bones on top and sides of head, except the cheeks, striated; mouth small, lips thin; teeth with denticulate edges. Gill-opening short, almost as long as the snout; gill rakers few and very short. Origin of dorsal over that of pectoral, and just a trifle behind the eye; spinous dorsal graduated to the last spine, which is the longest, though not equal to the longest rays, and covered for the most part with rather thick skin; soft dorsal rounded to the last rays, which are the shortest; anal graduated to the third spine, which is the

longest, covered with thick skin, and not equal to the highest anal rays which are about the middle of the fin; pectoral much longer than the head; ventral below pectoral and equal to two-thirds its length; caudal slightly convex, the corners sharp. Space before spine on the caudal peduncle covered with a tract of short, stiff, bristle-like spines. Caudal spine sharp, strong, and equal to the eye. Caudal peduncle compressed, not thick, and 3 in the head. Color pale brown (sometimes bright lemon yellow), a silvery streak from gill-opening above pectorals on the sides. Length $7\frac{5}{6}$ inches. Described from an example from Okinawa of the brown variety called *Zebrasona rhombeum*.

Of this species we have received one specimen, typical of *Acanthurus scopas*, from Nafa in Okinawa, where it was collected by Yonekichi Koneyama.

The form known as *Zebrasona flarescens*, bright lemon yellow in color, found at Hawaii, is considered by Dr. Günther as an albino form of *Zebrasona rhombeum*. On comparison of our specimen with those from Hawaii, we find no difference whatever except in color. Probably the typical *flarescens* is found in deep water, the variety *rhombeum* living near the shore. Such variations from brown to yellow are found in *Siganus*, *Pelor*, *Antennarius*, and other genera.

(*flarescens*, growing yellow.)

14. XESURUS Jordan and Evermann.

Xesurus JORDAN and EVERMANN, Check-list Fishes, 1896, p. 421 (*punctatus*).

Teeth in 1 row, each 5-lobed; caudal peduncle armed with 3 or 4 large bony plates, placed in a right line, each one with a bluntish, non-serrated keel. Ventral rays I, 5. Dorsal with 8 or 9 spines; anal with 3. This genus is close to *Prionurus* Lacépède, differing chiefly in the character of the caudal armature, the plates in *Prionurus* being small, sharper, serrated, and 6 in number, besides a smaller plate below and one above.

(ἔξις, scraping; οὐρά, tail.)

24. XESURUS SCALPRUM (Cuvier and Valenciennes).

NIZA, NISADAL.

Acanthurus scalprum LANGSDORF, Ms.

Prionurus scalprum CUVIER and VALENCIENNES, Hist. Poiss., X, 1835, p. 298; Japan.—SCHLEGEL, Fauna Japonica, 1847, p. 129, pl. LXX; Nagasaki.—GÜNTHER, Cat. Fish, III, 1861, p. 347; Japan.—STEINDACHNER and DÖDERLEIN, Fische Japans, III, 1884, p. 38; Tokyo.—NYSTROM, Svensk, Vet. Handl., 1887, p. 37; Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 34; Boshu.—JORDAN and SNYDER, Check-List, 1901, p. 91; Yokohama.

Naseus scalprum BLEEKER, Act. Soc. Sci. Indo. Nederl., VIII, Japan, VI, 1860, p. 79; Nagasaki.

*Etropus*¹ *fumosus* BREVOORT, Exped. Japan, 1856, p. 264, pl. vi, fig. 1; Nafa, Riu kiu Islands (Young called *Sumikakuwo*, soot-fish).

¹This name has been misquoted "*Etsgilus*," but *Etsgilus* is a misprint and does not occur in Brevoort's paper.

Head $3\frac{1}{2}$; depth 2. D. IX-22; A. III-21 or 23; P. I-16; V. 1-5. Body elliptical and compressed, skin fine velvety. Head small, longer than deep; eye high, 4 in head, $2\frac{2}{3}$ in the snout and $1\frac{1}{2}$ in interorbital space; snout concave, produced, but the upper profile of the head convex over the eyes; mouth small, terminal, and below the middle of the head; teeth with denticulate margins, the jaws subequal; anterior nostrils below the middle, and half the eye from its anterior margin, and the posterior a nearly horizontal slit between; interorbital space convexly flattened; angle of preoperculum very obtuse. Gill-opening very oblique, gill rakers short. Spinous dorsal more or less embedded in skin, its origin over that of the pectoral, the middle and last spines the highest, and much longer than the soft dorsal rays, which become gradually smaller to the last; anal spines graduated to the third, which is the longest though not as long as the longest anterior rays of the soft anal; the soft anal is similar to the soft dorsal; pectoral smaller than the head; origin of dorsal below the fifth dorsal spine, extending to the base of the second anal spine, and equal to two-thirds the length of the pectorals; caudal emarginate, the lobes pointed. Caudal peduncle rather thick, deeper than broad, and not quite equal to the eye. Sides of caudal peduncle with a single series of 4 bony bucklers, each with a produced median keel, compressed, extending outward, and largest on the last. Lateral line high, arched, and concurrent with the back. General color dusky brown in alcohol, the bases of the first 3 bucklers on the caudal peduncle blackish brown; the edges of the fins dark, except the very narrow white edge of the caudal, otherwise plain. Total length $9\frac{1}{2}$ inches.

Here described from Nagasaki specimens. In very young specimens from Misaki the body is very deep; the depth $1\frac{2}{3}$ the length; the highest part of the fin rays very high; the general color dark livid brown; dorsal and anal very dark, the soft fins broadly edged with white; caudal and caudal peduncle light, shaded with dark at its base; pectorals dark; skin smooth. In still smaller specimens the body is deeper, $1\frac{1}{2}$ in the length, the second dorsal spine as long as the pectoral and very much higher than the rest of the fin, and the body furnished with many vertical striæ; the trunk marked with narrow vertical bands.

This fish is rather common about rocky headlands in southern Japan. Our specimens are from Tokyo, Misaki, and Wakanoura. From the tide-pools of Misaki we have a very large series showing the stages of growth of the young. These are more or less yellowish in color, the fins, except caudal and pectoral, dusky. The caudal is yellow, with a black crossbar at its base.

The species can be known from the young of other *Acanthuridæ* by the number of its ventral rays, anal spines, and the soft rays of its dorsal and anal.

(*scalprum*, a sharp knife.)

15. ACANTHURUS Forskål.

Acanthurus FORSKÅL, Descr. Anim., 1775, p. 59 (*unicornis*).

Monoceros SCHNEIDER, Syst. Ichth., 1801, p. 186 (*biaculeatus*).

Naso LACÉPÈDE, Hist. Nat. Poiss., III, 1802, p. 106 (*fronticornis*).

Nasomus RAFINESQUE, Anal. Nature, 1815, substitute for *Naso*.

Priodon (Cuvier) QUOY and GAIMARD, Voy. Uranie, Zool., 1824, p. 377 (*annulatus*).

Naseus CUVIER, Règne Animal, 2d ed., II, 1829, p. 224 (*fronticornis*).

Priodontichthys BONAPARTE, Describ. Metod. Anim. Vest., 1833, p. 34 (*annulatus*).

*Keris*¹ CUVIER and VALENCIENNES, Hist. Nat. Poiss., X, 1835, p. 304 (*anginosus*).

Body oblong, compressed, covered with small roughish scales; tail with two large immovable, bony keeled plates, these entirely wanting in young examples. Head in the adult with the forehead prominent, developing a very long bony horn above the eyes, the horn wanting in the young; teeth small in one series, slightly compressed incisors, usually with serrate edges. Ventral fins incomplete, the rays 1, 3. Dorsal with 5 or 6 spines; anal with 2 spines, the small first spine wanting. Intestinal canal elongate. Herbivorous fishes of the East Indian and Polynesian seas, some of them remarkable for the bony frontal projection, and for the large ornate caudal spines.

We separate from *Acanthurus* the genera called *Callicanthus*² and *Axinurus*³ (*thynnoïdes*). The three groups may be provisionally defined as follows:

- a. Forehead with an elongate, tapering, subcylindrical horn in the adult; tail with two bony plates; teeth small, serrulate.....*Acanthurus*.
- aa. Forehead without subcylindrical horn; the snout with or without a compressed crest.
 - b. Tail with two bony plates; dorsal spines 5 or 6; teeth serrulate...*Callicanthus*.²
 - bb. Tail with one bony plate; dorsal spines 4; teeth entire.....*Axinurus*.³

It seems to us that the generic name *Acanthurus* is available for the genus rather than the later name, *Monoceros*. The genus *Acanthurus* as founded by Forskål includes this genus and *Teuthis*. The first species named by Forskål, *unicornis* being taken as its type, *Acanthurus* becomes equivalent to *Monoceros*. If we follow the rule of allowing subsequent authors to fix the type, *Acanthurus* becomes, of course, a synonym of *Teuthis*, and the present genus must be called *Monocerus*. (*ἄκανθα*, spine; *οὐρά*, tail.)

¹The definition of the supposed genus *Keris* applies to the young of *Xesurus*. (Ventral rays 1, 5; anal spines 3.) But the figure of *Keris anginosus* does not support the description, and the number of fin rays shows it to be the young of some *Acanthurus*.

²*Callicanthus* Swainson, Class. Fishes, II, 1839, p. 256 (*elegans*).

³*Axinurus* Cuvier and Valenciennes, Hist. Poiss., X, 1835, p. 225 (*thynnoïdes*).

25. ACANTHURUS UNICORNIS (Forskål).

TENGUHAGI (LONG NOSED SCRAPER) IKKAKUHAGI (ACUTE ANGLE SCRAPER).

Chatodon unicornis FORSKÅL, Descr. Anim., 1775, p. 63; Red Sea.

Aspisurus unicornis RÜPPELL, Atlas Fische, 1828, p. 60; Red Sea.

Naseus unicornis GÜNTHER, Cat. Fish, III, 1861, p. 348; Frankland I., Red Sea, Aneitum, Ceylon.

Monoceros unicornis JORDAN and SNYDER, Check-List, 1901, p. 91; Misaki.

Monoceros biaculeatus SCHNEIDER, Syst. Ichthy., 1801, p. 180, pl. XLII (after Forskål).

Monoceros raii SCHNEIDER, Syst. Ichth., 1801, p. 181 (after *Monoceros piscis* Willoughby).

Naso fronticornis LACÉPÈDE, Hist. Poiss., III, 1802, p. 105, pl. XII, fig. 2; Ile de France.

Naseus fronticornis CUVIER and VALENCIENNES, Hist. Poiss., X, 1835, p. 259; Ile de France, Waigion, Guam, Sandwich Islands, Red Sea, Otaiti.—SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 129, pl. XIX; Nagasaki.

?*Keris anginosus* CUVIER and VALENCIENNES, Hist. Poiss., X, 1835, p. 304; no locality; D. VII, 26; A. III, 28; V. I, 5.

Naseus longicornis CUVIER, Guérin, Icon. Poiss., 1830-44, pl. XXXV, fig. 3; Ile de France.

Herspurus monoceros FORSTER, Descr. Anim., Ed. Licht., 1844, p. 219.

Aconurus aegyptius GRONOW, Syst., Ed. Gray, 1854, p. 191; Red Sea (after Hasselquist).

Aconurus corniger GRONOW, Syst., Ed. Gray, 1854, p. 192; Red Sea (after Forskål).

Head 4; depth $2\frac{1}{2}$. D. V-29; A. II-28; P. I-17; V. I-3. Body ovate, deep in front, compressed and fine, velvety, becoming rough in front of the caudal. Head long, the forehead with a long, produced horn, directed forward from the upper part of the eye; snout long, with the upper profile straight, long; eye 3 in the frontal spine, 4 in snout, and $5\frac{1}{2}$ in head; mouth small, the snout produced; nostrils one-half an eye diameter in front of eye and about level with its middle; gill-opening very long, longer than the snout. Origin of the dorsal over the gill-opening, behind the spines shorter than the longer rays, the edge straight and ending in a point; anal spines short, the rays equal, the edge straight and ending in a point; pectorals in front of the dorsal equal to the frontal spine; ventrals in front of the pectorals, the spines sharp and thick, $1\frac{3}{4}$ in snout; caudal compressed, the margin straight and the lobes produced into long filaments. Sides of caudal peduncle with two large compressed bucklers hooked forward. Lateral line very high and concurrent with the back. Color (dried) plain brown. Here described from a large dried specimen from Nagasaki. In the young, known by the number of the fin rays, the bony horn is wanting, and in the very young there is no trace of caudal plates. Specimens from Honolulu seem to agree perfectly with the one from Nagasaki.

This species, very abundant and widely diffused through the Indian

region and Polynesia, is rare in Japan, the adult only taken in the southern islands, the young extending in the Kuro Shiwo, to the rock pools as far north as Tokio. In our collection is one very large specimen from Nagasaki, a smaller one from Kiusiu, and a still smaller one from Misaki. This latter has no frontal spine and no caudal plates. This species is subject to very great variation with age. A very large example from Misaki is in the Imperial Museum at Tokyo. (*unicornis*, one-horned.)

Family VII. SIGANIDÆ.

Body oblong, compressed, covered with very small cycloid scales; lateral line continuous; tail unarmed. Mouth small, with a single series of serrated trenchant incisors in the jaws; no teeth on vomer or palatines. Pseudobranchiæ well developed. Gill-membranes not united; attached to the isthmus; branchiostegals 5. A single dorsal fin, its rays XIII, 10, the spines strong; anal rays VII, 9, the spines well developed. Ventral fins thoracic, each with an outer and an inner spine, and three soft rays between them. Caudal fin cunate. Air bladder large, forked before and behind. Intestinal canal with several convolutions; pyloric caeca 5 or 6. Vertebrae 10 + 13 = 23. Skeleton showing many peculiarities, the maxillary and premaxillary firmly united, the lower pharyngeals very little developed. Herbivorous fishes of the East Indian seas, all belonging to the single genus *Siganus*. The family is of uncertain affinities, and shows numerous peculiarities not found in related forms. It is probably nearest the *Acanthuridæ*.

16. SIGANUS FORSKÅL.

Siganus FORSKÅL, Descr. Anim., X, 1775, p. 26 (*siganus-rirolatus*).

Centrogaster HOUTTUYN, Acta Soc. Harlem, V, 1782, pp. 20, 333 (*fuscescens*).

Amphacanthus SCHNEIDER, Syst. Ichth., 1801, p. 206.

Teuthis CANTOR, Cat. Malayan Fishes, 1850, p. 207 (*javus*, and of numerous authors, not of Linnaeus).

The characters of the genus are included above.

(*Sidjan* or *Sigian*, the Arabian name of *Siganus siganus*.)

a. Color brown, gray, or yellow, usually with very numerous round, whitish spots.....*fuscescens*, 26.

aa. Color yellow, with oblique blue bands and streaks, distinct about the head.
virgatus, 27.

26. SIGANUS FUSCESCENS (Houttuyn).

ARGO (BLUE THING); GINHAGI (SILVERY SCRAPER); KIZINOUWO (PHEASANT FISH).

Centrogaster fuscescens HOUTTUYN, Act. Soc. Harl., XX, 1782, p. 333; Nagasaki.

Amphacanthus fuscescens CUVIER and VALENCENNES, Hist. Poiss., X, 1835, p. 156;

Japan.—SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 127, pl. LXVIII, fig. 1,

Nagasaki.—BLEEKER, Verh. Bat. Gen., XXVI, Japan, 1857, p. 106; Nagasaki.

Teuthis fuscescens GÜNTHER, Cat. Fish, III, 1861, p. 321 (copied).—STEINDACHNER and DÖDERLEIN, Fische Japans, III, 1884, p. 25; Tokyo.

Teuthis fuscescens NYSTROM, Svensk, Nat. Handl., 1887, p. 37; Nagasaki.

Siganus fuscescens JORDAN and SNYDER, Check-List, 1901, p. 92; Yokohama.

Amphacanthus albopunctatus SCHLEGEL, Fauna Japon, Poiss., 1847, p. 128; Nagasaki.

Teuthis albopunctata GÜNTHER, Cat. Fish, III, 1861, p. 318; Amoy, Philippines.—STEINDACHNER and DÖDERLEIN, Fische Japans, III, 1884, p. 25; Kagoshima.—ISHIKAWA, Prel. Cat., 1897, p. 34; Tokyo.

Amphacanthus aurantiacus SCHLEGEL, Fauna Japonica, 1847, p. 128; Nagasaki.

Amphacanthus margaritifera RICHARDSON, Ichth. China, 1846, p. 243; Canton (not of Cuvier and Valenciennes).

Teuthis brevisrostris GRONOW, Syst., Éd. Gray, 1854, p. 142; Indies.

Head $3\frac{2}{3}$ to $4\frac{2}{3}$; depth $2\frac{1}{2}$ to $2\frac{3}{4}$. D. I–XIII or XIV–10; A. VII–9; P. I–14 to 16; V. I–3–1. Body compressed, oblong, and covered with very small round scales. Head small, the profile concave above in front of the dorsal; eye moderate, not high, $3\frac{3}{4}$ in the head, $1\frac{1}{2}$ in the snout, and $1\frac{1}{2}$ in the interorbital space; snout convex above, very blunt and rounded, mouth inferior, the mandible not projecting, with the lower jaw fitting under the upper; maxillary expanded distally, its breadth at this point 4 in the snout, and not reaching as far posteriorly as the second nostril; nostrils level with the upper part of the eye, the first pair a little less than an eye diameter from the anterior margin of the eye, and the second a little nearer the first than the eye; teeth small and pointed; lips rather broad and thin; interorbital space convex. Gill-opening semicircular, moderate, and the membrane adnate to the isthmus. First spine of dorsal low, short, and directed forward, the rest of the spinous part of the fin occupying the greater part of the back, the spines shorter posteriorly; soft dorsal not as high as, and its base 3 in that of the spinous dorsal; anal midway between the tip of the snout and the base of the caudal, the middle spines the longest and the base of the spinous portion longer than the base of the soft rays; soft dorsal highest in front; pectoral $1\frac{2}{3}$ in the head, rounded; ventral a little behind the gill-opening, equal to two-thirds the space between their own tips and the origin of the anal; caudal lunate, the edges pointed. Caudal peduncle deeper than broad, though not quite equal to the eye. Anus between the ventrals posteriorly. Lateral line high, and concurrent with the back. Color in spirits rich chocolate-brown above, below silvery white; above and on the sides darker, marbled and mottled with darker; fins dark brown, marbled with darker, the pectoral and a bar on the caudal blackish. Here described from a specimen from Tokyo, $11\frac{2}{3}$ inches long. Smaller examples differ in color as follows:—Body covered with numerous small, round, light spots; caudal edged narrowly with light color like the back; fins blotched with light color, and a large dark-brown spot as large as the eye behind the opercle above.

This species is very common about rocky islands in the warm bays

of southern Japan. Our specimens of various ages were obtained at Tokyo, Yokohama, Misaki, Wakanoura, Kobe, Onomichi, Hakata, Kawatana, and Nagasaki.

We are unable to distinguish more than one species among all our Japanese specimens. All show the small white spots characteristic of *albo-punctatus*. It is probable that *fuscescens* represents a very dark specimen like some of ours from Tokyo Bay in which the spots are very obscure. Those called *aurantiacus* represent an orange-colored variation probably found in examples from deeper waters. *Siganus oramin*, of India, seems to be somewhat different, having the spots larger and sparser and the caudal banded.

(*fuscescens*, dusky.)

27. SIGANUS VIRGATUS (Cuvier and Valenciennes).

Amphacanthus virgatus CUVIER and VALENCIENNES, Hist. Poiss., X, 1835, p. 133; Java.

Teuthis virgata GÜNTHER, Cat. Fish., III, 1861, p. 323; China, Philippines.—
ISHIKAWA, Prel. Cat. 1897, p. 34; Miyakoshima.

D. XIII-10; A. VII-9; Cæc. pylor. 4. Body light brownish-yellow, forehead and neck with bluish transverse stripes; an oblique, deep brown, blue-edged band descends from the fourth and sixth dorsal spines to the root of the pectoral; a second similar band from the origin of the dorsal to the orbit; the space between the two bands is yellow; scattered blue dots on the upper parts of the body; some oblique bluish streaks on the snout.

(Description after Cuvier, Valenciennes, Günther.)

Of this East Indian species one specimen from Miyakoshima is preserved in the Imperial Museum at Tokyo.

(*virgatus*, streaked.)

SUMMARY.

Family I. ZEIDÆ.

1. *Zenopsis* Gill.

1. *nebulosa* (Schlegel); Tokyo, Misaki.

2. *Zeus* Linnaeus.

2. *japonicus* Cuvier and Valenciennes, Tokyo, Misaki, Kobe, Hiroshima, Suruga, Nagasaki.

3. *Cyttopsis* Gill.

3. *itea* Jordan and Fowler; Suruga Bay.

Family II. ANTIGONIDÆ.

4. *Antigona* Lowe.

4. *steindachneri* Jordan and Evermann; Hilo, Kailua, Honolulu.

5. *rubescens* (Günther); Totomi Bay, Misaki, Suruga Bay.

Family III. PLATACIDÆ.

5. *Platax* Cuvier.

6. *teira* (Forskål); Formosa, Kezen, Riukiu, Bonin Islands, Tokyo, Punjako (near Morioka).

Family IV. CHELODONTIDÆ.

6. *Chelodon* (Artedi) Linnæus.

7. *setifer* Bloch; Nafa, Okinawa.
 8. *vagabundus* Linnæus; Nafa, Okinawa.
 9. *collaris* Bloch; Ikune, Satsuma.
 10. *modestus* Schlegel; Misaki.
 11. *nippon* Döderlein; Totomi Bay, Misaki, Tokyo.
 12. *dardania* Jordan and Fowler; Nafa, Okinawa.

7. *Coradion* Kaup.

13. *desmotes* Jordan and Fowler; Nagasaki.

8. *Microcanthus* Swainson.

14. *strigatus* (Cuvier and Valenciennes); Tokyo, Misaki, Nagasaki.

9. *Hemiochus* Cuvier and Valenciennes.

15. *macrolepidotus* (Linnæus); Wakanoura, Nagasaki.

10. *Holacanthus* Lacépède.

16. *septentrionalis* Schlegel; Ikune.
 17. *rouin* Jordan and Fowler; Misaki, Wakanoura.
 18. *tibicen* Cuvier and Valenciennes; Nafa, Okinawa.

Family V. ZANCLIDÆ.

11. *Zanclus* Cuvier and Valenciennes.

19. *canescens* (Linnæus); Misaki.

Family VI. ACANTHURIDÆ.

12. *Tenthis* Linnæus.

20. *triestegus* (Linnæus); Okinawa, Misaki.
 21. *argenteus* (Quoy and Gaimard); Nafa, Umesawa, Misaki.
 22. *bipunctatus* (Günther); Kotosho, Formosa.

13. *Zebrasoma* Swainson.

23. *flavescens* (Bennett); Nafa, Okinawa.

14. *Nesurus* Jordan and Evermann.

24. *scalprum* (Cuvier and Valenciennes); Tokyo, Misaki, Wakanoura.

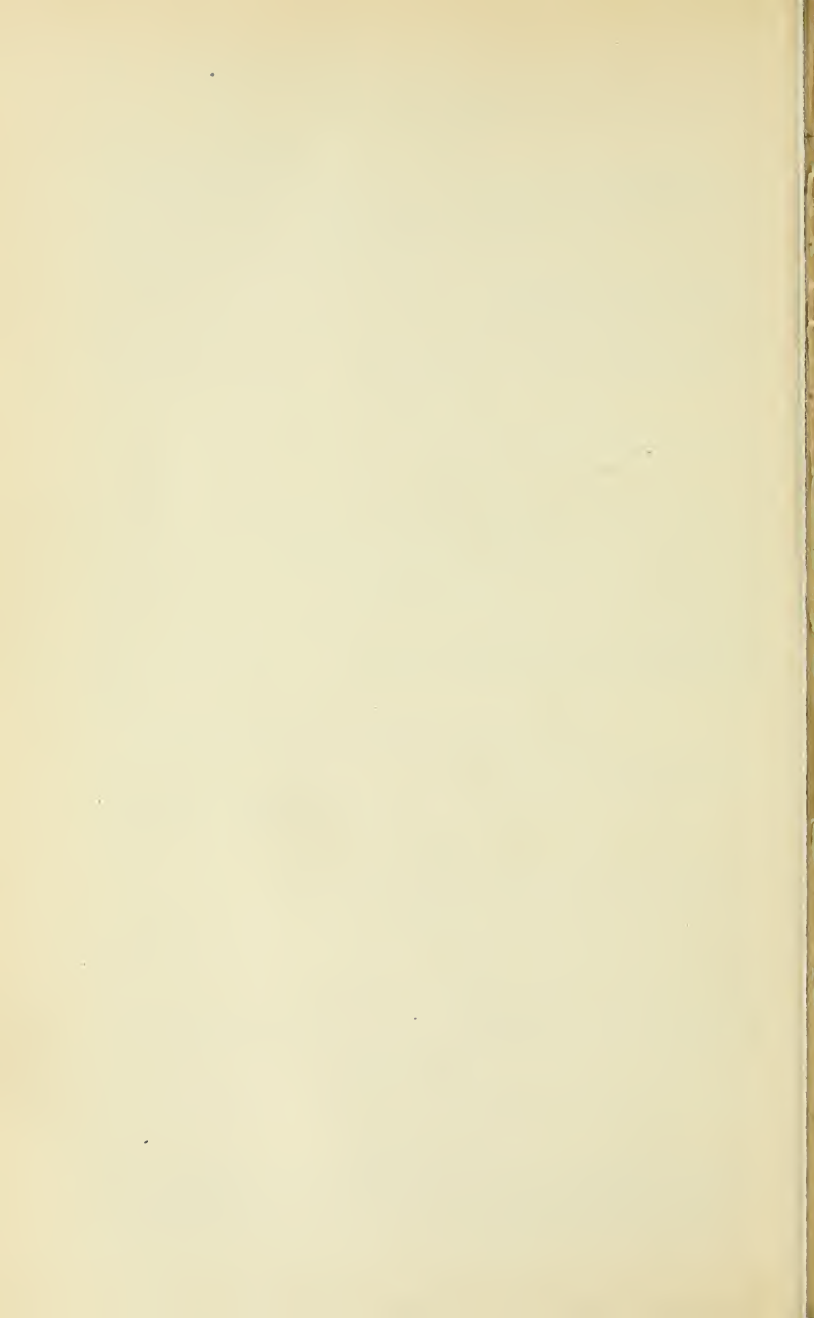
15. *Acanthurus* Forskål.

25. *unicornis* (Forskål); Misaki, Nagasaki.

Family VII. SIGANIDÆ.

16. *Siganus* Forskål.

26. *fuscescens* (Houttuyn); Tokyo, Yokohama, Misaki, Wakanoura, Kobe, Onomichi, Hakata, Kawatana, Nagasaki.
 27. *virgatus* (Cuvier and Valenciennes).



THE RELATIONSHIP AND OSTEOLOGY OF THE CAPROID FISHES OR ANTIGONIIDÆ.

By EDWIN CHAPIN STARKS,
Of the Leland Stanford Junior University.

INTRODUCTION.

The osteological characters of the family Antigoniiidæ (Caproidæ) as exhibited by the Japanese species *Antigonia rubescens* (Schlegel) point to an affinity with the Chaetodonts. The following characters seem to indicate a rather close relationship:

1. *The striking similarity in appearance and construction of the cranium to that of the genus Chaetodon.*

2. *The continuity of the supraoccipital crest with the pterotic crest.*

In both *Antigonia* and *Chaetodon* the supraoccipital crest is high and declivitous; its anterior edge is thickened to a ridge on each side, which descends in a curve, and is continuous backward with the pterotic crest.

3. *The simple unforked posttemporal.*

In *Chaetodon* the posttemporal is a simple, straight bone, with a slight tubercle developed at its lower end (in place of the usual lower fork) for attachment to the opisthotic. The posttemporal in *Antigonia* shows even a greater degree of modification, the tubercle being entirely absent.

4. *The imperforate prefrontals.*

In the bony fishes the olfactory foramen is typically through the center of the prefrontal. In *Antigonia* it is between the prefrontal and the ethmoid. *Chaetodon* and *Holocanthus* approach the latter condition in having the foramen barely contained by the prefrontal. Only a slight lamina of bone saves it from being between the prefrontal and the ethmoid.

5. *The meeting of the alisphenoids and consequent division of the anterior opening to the brain case.*

A character shared by *Antigonia*, *Chaetodon*, and *Holocanthus*.

6. *The enlarged first interhæmal.*

The first interhæmal in the Chaetodonts and in *Antigonia* is very

stout and long, running up to the vertebral column at the posterior part of the abdominal cavity. It is firmly held against the first hæmal spine. In *Chatodon* and *Antigonia* it is composed of the first three interhæmals coössified. In *Holocentrus* it is composed of the first two.

With the family Zeidæ (which, though perhaps related to the Chatodonts, seems to have no close affinities with any known family) *Antigonia* has the following characters in common:

Posttemporals unforked; prefrontals not perforated by the olfactory nerve; first interhæmal much enlarged, bordering the posterior part of abdominal cavity and reaching up to first abdominal vertebra.

DESCRIPTION OF OSTEOLOGY.

CRANIUM.

The occipital crest is high and declivitous; its anterior edge is thickened to a ridge on each side, which descends in a curve and is continuous with the pterotic ridge.

The anterior edge of the supraoccipital and the surface of the frontals bear sharply denticulated ridges, and all of the bones which are in contact with the skin are covered with small sharp spines.

The auditory organ forms a protruding capsule of thin, polished bone on each side.

The supraoccipital extends forward to above the middle of the eyes and widely separates the posterior ends of the frontals.

At the sides the frontals spread out fan-shaped, and rise steeply to the supraoccipital. They nearly reach to the pterotic supraoccipital crest posteriorly. Anteriorly they are deeply excavated for the reception of the backward-extending process from the premaxillaries. From above the orbital space a channel runs anteriorly from each frontal, and is continued on nasals to their anterior end.

The ethmoid is very small and is in a depression in the upper surface of the vomer. It bears a sharp keel above, which is on a level with the floor of the anterior frontal excavation.

The prefrontal is not pierced by the olfactory nerve; the olfactory foramen is between it and the ethmoid.

The nasal is large and curves downward at its end to the palatine, to which it is securely attached.

The vomer sends lateral wings upward from its sides, which are articulated to the prefrontal.

The parasphenoid expands laterally at the front of the prootic, and bounds the lower part of the myodome. From its lower surface a thin keel is developed. It extends, splint-like, over the basioccipital, reaching nearly to the posterior end of that bone.

The exoccipitals meet above and below the foramen magnum. From their posterior surface wings are developed for the reception of the end of the large second interneural.

The prootic forms the greater part of the myodome and auditory capsule.

A small basisphenoid bridges the lower part of the anterior opening to the brain case between the prootics. It has a small tubercle developed on its anterior edge, but it has no descending process.

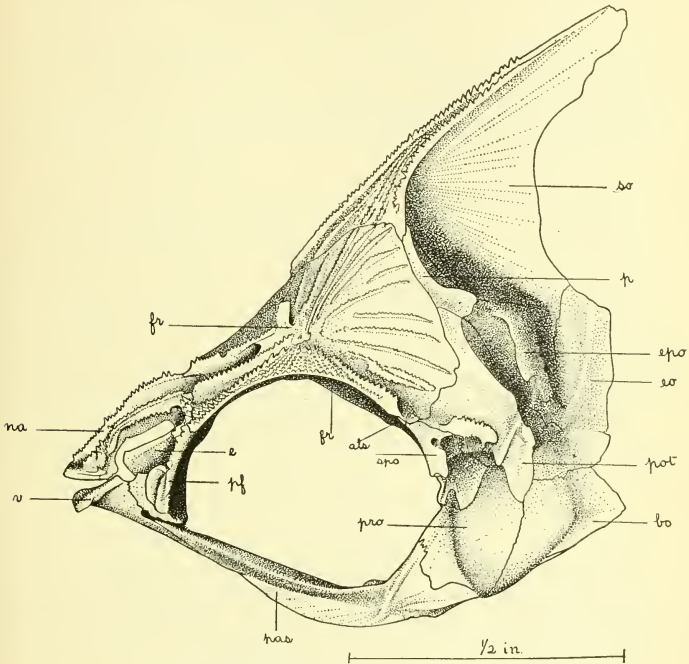


FIG. 1.—LATERAL VIEW OF CRANIUM OF ANTIGONJA RUBESCENS.

als alisphenoid.
bo basioccipital.
e ethmoid.
eo exoccipital.
epo epiotic.
fr frontal.
na nasal.
p parietal.

pas parasphenoid.
pf prefrontal.
pot pterotic.
pro prootic.
so supraoccipital.
spo sphenotic.
v vomer.

The alisphenoids are united with each other and widely separate the upper and lower parts of the anterior opening to the brain case.

The pterotic sends a thin wing of bone downward and the opisthotic is developed over the posterior edge of its base. The posttemporal is securely attached at its lower end to the opisthotic.

The epiotic process is developed laterally and receives on its posterior surface the upper end of the posttemporal.

The parietals are largely covered by the frontals and show little except their posterior face behind the pterotic occipital crest.

The myodome is very large at its mouth, and tapers quickly to an extremely small pore opening to the exterior posteriorly.

LATERAL BONES OF HEAD.

The opercle is rather elongate and bears the subopercle on its lower posterior margin.

The interopercle occupies a peculiar position. It extends behind the large preopercle straight between the angular and the subopercle,

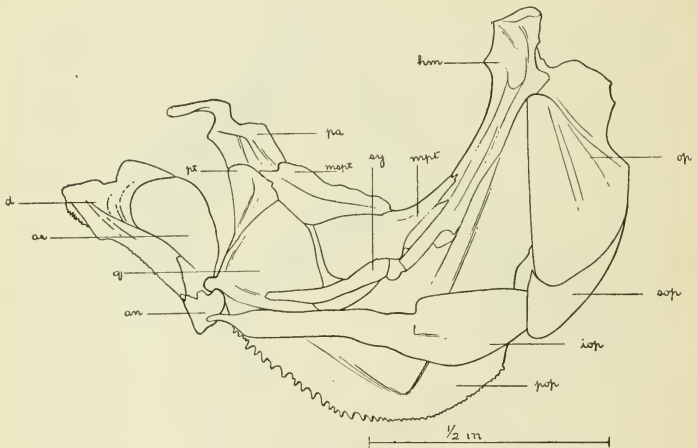


FIG. 2.—INNER SIDE OF "FACE BONES" OF *ANTIGONJA RUBESCENS*.

- | | |
|----------------------------|------------------------|
| <i>an</i> angular. | <i>op</i> opercle. |
| <i>ar</i> articular. | <i>pa</i> palatine. |
| <i>d</i> dentary. | <i>pop</i> preopercle. |
| <i>hm</i> hyomandibular. | <i>pt</i> pterygoid. |
| <i>io</i> interopercle. | <i>q</i> quadrate. |
| <i>mpt</i> metapterygoid. | <i>sop</i> subopercle. |
| <i>mspt</i> mesopterygoid. | <i>sy</i> symplectic. |

and is almost entirely concealed from the outside by the large preopercle. At its middle is a small articular facet to which the end of the epiphyal is attached.

The preopercle is very large. A ridge runs straight from its upper to near its lower margin, turns sharply at an angle, which is slightly more acute than a right angle, and runs straight to near the condyle of the lower jaw.

The head of the hyomandibular is undivided where it articulates

with the cranium. The process which it sends down to the symplectic is rather long and slender. To its anterior edge the metapterygoid sends a process which is connected to it suturally.

The palatine is short and broad, and is supported equally by the mesopterygoid and the pterygoid.

The pterygoid is triangular in shape, and occupies a position against the upper two-thirds of the quadrate.

The symplectic runs along the inner face of the quadrate to about the middle of that bone.

The mandible is very broad. There is no open space between the articular and the dentary. The edge of the dentary is raised abruptly above the level of the teeth at its posterior upper edge. Below it runs back to the angular.

The angular is well developed, and is connected to the anterior end of the interopercle by a ligament.

The preorbital and suborbitals are covered with small sharp points, and have the usual canal following their course. There is no suborbital shelf.

The maxillary and premaxillary resemble those of *Zeus*, though very small in comparison.

The backward extending process from the premaxillary runs obliquely upward, and is much longer than the lateral portion which forms the edge of the mouth.

The maxillaries curve forward below over the ends of the premaxillaries.

HYOID AND BRANCHIAL ARCHES.

The hypohyals are large and flat, the lower one the larger.

The ceratohyal is pierced by a large hole at its upper edge.

The epihyal is much deeper than long and bears a stout interhyal. Four of the six branchiostegals are attached to it; two to the ceratohyal.

The urohyal is very large; it reaches past the posterior end of the epihyal, and is nearly as deep as it is long.

The branchial bones are all present except the hypobranchial, as is usual. The inferior pharyngeals are rather long and are well separated. The toothed superior pharyngeals are three in number, one to each of the three posterior arches. They decrease in size backward, and each bears a single row of sharp curved teeth.

SHOULDER GIRDLE.

The posttemporal is not forked, and no tubercle is developed at its lower end for connection to the cranium. It is much widened at its lower end.

The supraclavicle is rather elongate and does not depart from its usual condition.

The lower elements of the shoulder girdle form a wide plate. The lower part of the clavicle is widened and the hypercoracoid is separated from it for most of its length by a large space, which is inclosed below by two small slender spurs, one reaching backward from the clavicle and another reaching forward from the hypercoracoid. The upper

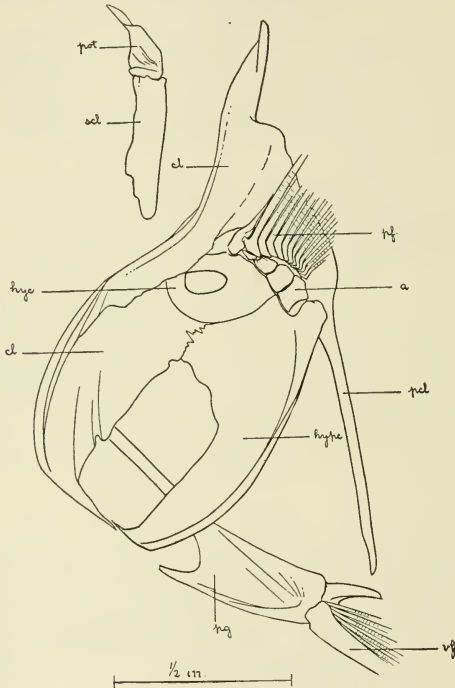


FIG. 3.—SHOULDER GIRDLE OF *ANTIGONJA RUBESCENS*.

a actinosts.
cl clavicle.
hyc hypercoracoid.
hycr hypocoracoid.
pcl postclavicle.

pf pectoral fin.
pg pelvic girdle.
pot posttemporal.
scl supraclavicle.
vf ventral fin.

part of the hypercoracoid is connected to the clavicle by a rather short dentate suture. A thin crest springs from the posterior edge of the hypercoracoid and curving backward forms a small channel behind it.

About half of the hypercoracoid is above the hypocoracoid and half above the lower lamina of the clavicle. The opening through its center is large.

There are four short actinosts, the upper one the shortest. They are but slightly constricted at their middles. Three are borne by the hypercoracoid; one by the hypocoracoid.

The first upper short spine or simple ray of the pectoral works directly upon a condyle on the hypercoracoid.

The postclavicle is a single long spine curving downward toward the ventrals. Its upper end has a thin bony lamina developed above and below. It is firmly attached to the clavicle above.

PELVIC GIRDLE.

The opposite sides of the pelvic bones are suturally attached to each other. They send a long slender spine forward between the hypocoracoids and the clavicles. The spine fails to reach the anterior edge of the clavicles by some distance. A shorter, thicker spine runs forward below and at a slight angle with the upper one nearly to the lower end of the hypocoracoid. A thin lamina of bone bridges the space between the spines forming a chamber which is wide open in front and opens behind at each side of a short, vertical, intersecting partition on the lower surface of the girdle just in front of the ventral fins. A short process springs from the upper posterior end, just above the condyle for the ventral fins, and projects a short distance over the fins.

VERTEBRAL COLUMN AND APPENDAGES.

There are 9 abdominal vertebrae and 11 caudal, which, with the hypural, make 21.

The atlas is larger than the other vertebrae and is obliquely truncated on its lower anterior edge as in *Chaetodon*.

The zygapophyses are very small and are only developed anteriorly.

The parapophyses are not developed on the first four vertebrae. They grow progressively longer posteriorly.

Anteriorly the ribs are borne in pits on the centra of the vertebrae. As usual the first two vertebrae bear only epipleurals. Epipleurals are present on all ribs and are continued some distance behind the abdominal cavity.

The first tiny dorsal spine is attached to a small interneural which is coössified with the second interneural by a thin lamina of bone. The interneural reaches down nearly to the tip of the supraoccipital crest and helps to form the anterior outline of the body.

The second small dorsal spine is borne by an immense interneural which reaches to the base of the cranium and is clasped by two wings from the exoccipitals. A lamina of bone is developed on its posterior edge.

The third dorsal spine, though many times larger than the second is carried by a smaller interneural. The succeeding interneurals grow progressively smaller.

The interneurals from the dorsal spines lead each to a neural spine. Those from the dorsal rays are about three to each neural spine.

The three anal spines are attached to a single large interhamal, doubtless composed of the first three interhamals coössified. It reaches upward to the under surface of the first caudal vertebra.

The interhamals of the anal rays exceed the hamal spines in number in the same proportion as the interneurals of the dorsal rays exceed neural spines.

NOTES ON LITTLE-KNOWN JAPANESE FISHES WITH
DESCRIPTION OF A NEW SPECIES OF ABOMA.

By DAVID STARR JORDAN and HENRY W. FOWLER,
Of the Leland Stanford Junior University.

In overhauling the Japanese collections of Jordan and Snyder a few specimens have been found which had been overlooked in the reviews of different families already published. Notes on these, giving additional features or additional localities, are here presented.

Family ANGUILLIDÆ.

ANGUILLA JAPONICA Schlegel.

Two small specimens from the Yodo River in Osaka.

Family LEPTOCEPHALIDÆ.

LEPTOCEPHALUS NYSTROMI Jordan and Snyder.

A single specimen from Morioka in Oshima, Hokkaido, differs but little from the type.

Head $1\frac{1}{2}$ in trunk; head and trunk $1\frac{1}{2}$ in tail; mouth reaching middle of eye; eye about $4\frac{1}{2}$ in head; lower jaw included; snout cavernous, $3\frac{2}{3}$ in head; eye about $1\frac{1}{6}$ in snout; pectoral about 3 in head; dorsal inserted before middle of pectoral; gill-opening below pectoral, and the space between its upper margin and origin of dorsal, when viewed laterally, about $5\frac{2}{3}$ in head; tail ending in a point.

The color has almost entirely faded except the brownish-black margin of the ventral fin posteriorly. Total length $14\frac{1}{2}$ inches (368 millimeters).

Family APOGONIDÆ.

SYNAGROPS JAPONICA (Döderlein).

Head $2\frac{1}{6}$; depth $3\frac{3}{4}$; depth of caudal peduncle $3\frac{3}{4}$ in head; interorbital space 4; snout a little over 4; maxillary 3. D. IX-I, 9; A. II, 7; squamation injured.

Body rather oblong, back not elevated; caudal peduncle compressed; head compressed laterally, almost as deep as body and with the upper profile straight; snout convex; occiput rather flattened, interorbital space convex and about three-fourths diameter of eye; eye large, greater than snout; preorbital narrow, its greatest width one-third eye; snout rounded obtusely, convex above, lower jaw projecting; maxillary reaching first third of eye, its posterior edge concave; upper jaw with 2 or 3 large sharp canines; lower jaw with 2 pairs of median canines and 5 lateral canines, the posterior of the latter the largest; both jaws with their edges finely roughened; vomer with a patch of small teeth; palatines with small teeth; tongue pointed, without teeth, and free in front; gill-rakers rather long, 3+13 on the first arch; pseudo-branchiæ large; edge of preopercle with fine denticulations; branchiostegals 7; head, except lips and branchiostegal region, covered with small scales; many pores above and on jaws.

First dorsal spine about one-fourth length of second, inserted close to it; fourth spine longest, the others progressively shorter to the last, which is about equal to first; fin, when depressed, fitting into a narrow groove but its tip not reaching base of soft dorsal; spine of soft dorsal close to first ray, the fin in advance of the anal, so that the origin of the latter falls about under its middle; pectorals longer than ventrals and with their tips reaching origin of soft dorsal; ventrals directly below pectorals and pointed; caudal emarginate, the lobes distinct. Color entirely faded in alcohol. Length 104 millimeters.

This description from a single specimen dredged by the U. S. Fish Commission steamer *Albatross* in Suruga Bay.

The name *Melanostoma* being preoccupied, Dr. Günther has suggested *Synagrops* as a substitute.¹

Family TETRAODONTIDÆ.

SPHEROIDES OCELLATUS (Osbeck).

A single small specimen, 36 millimeters long, from the Yodo River, Osaka. The black ocelli are joined by a black band across the shoulders.

EUMYCTERIAS RIVULATUS (Schlegel).

We have specimens from Okinawa and from Totomi Bay, the latter dredged by the U. S. Fish Commission steamer *Albatross* at Station 3729.

Family GOBIIDÆ.

ODONTOBUTIS OBSCURUS (Schlegel).

One specimen from Lake Yogo, in Mino, above Lake Biwa.

¹ Rept. Fishes Challenger, 1887, p. 16.

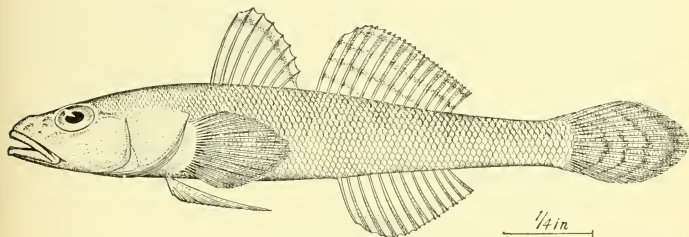
CTENOGOBIOUS SIMILIS (Gill).

One example from Kumashiro.

ABOMA SNYDERI Jordan and Fowler, new species.

Head 3; depth 5; depth of caudal peduncle 4 in head; eye 4 in head; snout 3; maxillary 3. D. VII or VIII-14; A. 12; scales about 56 in a lateral series, in a transverse series about 16.

Body rather elongate, gradually tapering backwards; head wider than body, but less deep, the sides rather compressed; snout blunt, rounded when viewed laterally, and truncately rounded when viewed from above; eyes high in head, anterior, and very close together, directed upwards, the interorbital space very narrow and concave; jaws subequal; mouth large, the maxillary reaching eye; space between lower margin of orbit and posterior edge of maxillary less than eye; tongue broad, its edge rounded anteriorly, free in front; teeth in villiform bands in the jaws, with an outer enlarged series;



ABOMA SNYDERI.

gill-openings rather large, the isthmus broad. Head naked, except the upper portion of the opercles, which are covered with small scales; scales on the nape very small. Dorsal fins separate from each other and from the caudal; first dorsal spine the longest, the others progressively smaller, when depressed, not reaching origin of soft dorsal; dorsal rays, when depressed, falling far short of base of caudal; anal inserted a little behind soft dorsal and falling a little below second or third ray; anterior rays of soft dorsal and anal the longest, the posterior not much elongated or produced; pectoral rather larger, and, when depressed, reaching origin of soft dorsal; ventrals rather long, but shorter than the pectorals, free posteriorly.

Color in alcohol, pale brown, darker above, very pale below; on the upper surface everywhere with small, indistinct, darker spots and reticulations; side with a series of rather large dark blotches; spinous dorsal pale, marked with 4 or 5 narrow, blackish brown, longitudinal bands; soft dorsal of similar color and also marked with about 4 lon-

gitudinal, blackish-brown bands; a black spot upon the upper part of the spinous dorsal posteriorly; anal, pectorals, and ventrals pale; a dark spot on the base of the pectorals above; caudal pale, with about 4 vertical, broad, blackish-brown bars.

Four specimens were taken in a little pond in Aomori.

Type No. 7193, Ichthyological Collections, Leland Stanford Junior University Museum. Cotypes are in the U. S. National Museum.

(Named for John O. Snyder, curator of fishes, Stanford University.)

Measurements of Aboma snyderi.

Total length in millimeters.....	33	45	47	49.
Total length without caudal.....	26	36	37	38
Depth.....	5	7	7	8
Head.....	9	12	13	13
Eye.....	2	3	3	3
Snout.....	2.5	4	4	4
Interorbital space.....	.5	1	1	1
Length of pectoral.....	6	8	8	8
Dorsal spines.....	VIII	VII	VIII	VIII
Dorsal radii.....	14	14	14	14
Anal radii.....	12	12	12	12
Pectoral rays.....	21	21	20	20

This species is very close to *Aboma breunigi* (Steindachner), agreeing with it more or less in color, but differing from it and the other species of the genus in the greater number of soft dorsal rays and the scaly opercles.

CHÆNOGOBIUS MACROGNATHOS (Bleeker).

Yodo River in Osaka.

CHASMICHTHYS MISAKIUS Jordan and Snyder.

We have three examples from Wakanoura.

The generic name *Chasmias* being preoccupied, Jordan and Snyder have substituted *Chasmichthys* for it.

TRIDENTIGER OBSCURUS (Schlegel)

Two large specimens from the Kitakami River.

TRIDENTIGER BUCCO Jordan and Snyder.

One specimen from Tamagawa at Tachikawa.

TRIDENTIGER BIFASCIATUS Steindachner.

Specimens from Wakanoura.

CAMBRIAN BRACHIOPODA: ACROTRETA: LINNARSSON-
ELLA; OBOLUS; WITH DESCRIPTIONS OF NEW
SPECIES.

By CHARLES D. WALCOTT.

Honorary Curator, Division of Stratigraphic Paleontology.

I had hoped to complete the monograph on the Cambrian Brachiopoda before this time, but owing to the large accessions of new material and to increased administrative duties this has been impracticable. The following additional¹ notes are therefore published, in the hope that they may be of service to students prior to the appearance of the monograph.

Genus ACROTRETA Kutorga.

1848. *Acrotreta* KUTORGA, Verhandl. der russisch-Kais. Min. Gesellsch., St. Petersburg, p. 275.
1853. *Acrotreta* DAVIDSON, Introduction British Fossil Brachiopoda, p. 133.
1865. *Acrotreta* VON SEEBACH, Feitschr. deutsch. geol. Gesellsch., XVII, p. 341.
1865. *Acrotreta* BILLINGS, Paleozoic Fossils, I, p. 216.
1871. *Acrotreta*? DAVIDSON, British Sil. Brachiopoda, p. 343.
1872. *Acrotreta* MEEK, Sixth Ann. Rept. U. S. Geol. Sur. Terr., p. 462.
1874. *Acrotreta* WHITE, Geog. Sur. W. 100th Merid., IV, Pt. 1, p. 53.
1876. *Acrotreta* LINNARSSON, Bihang till K. Svenska vet. Acad. Handl., III, No. 12, Brachiopoda Paradoxides Beds of Sweden, p. 16.
1883. *Acrotreta* DAVIDSON, British Sil. Brach. Supl., p. 213.

¹Note on the genus *Lingulepis*, Amer. Jour. Sci., 4th ser., III, 1897, pp. 404, 405.
Cambrian Brachiopoda: Genera *Iphidea* and *Yorkia*, with descriptions of new species of each, and of the genus *Acrothele*, Proc. U. S. Nat. Mus., XIX, 1897, pp. 707-718.

Note on the brachiopod fauna of the quartzitic pebbles of the Carboniferous conglomerates of the Narragansett Basin, Rhode Island, Am. Jour. Sci., 4th ser., VI, 1898, pp. 327, 328.

Cambrian Brachiopoda: *Obolus* and *Lingulella*, with description of new species, Proc. U. S. Nat. Mus., XXI, 1898, pp. 385-420.

Cambrian Brachiopoda: *Obolella*, subgenus *Glyptias*; *Bicia*; *Obolus*, subgenus *Westonia*; with descriptions of new species, Proc. U. S. Nat. Mus., XXIII, 1901, pp. 669-695.

1884. *Acrotreta* WALCOTT, Mong. U. S. Geol. Sur., VIII, p. 16.
1886. *Acrotreta* MATTHEW, Trans. Roy. Soc. Canada, III, p. 36.
1886. *Acrotreta* WALCOTT, Bull. U. S. Geol. Sur., No. 30, p. 98.
1891. *Acrotreta* WALCOTT, Tenth Ann. Rept. U. S. Geol. Sur., p. 608.
1892. *Acrotreta* HALL and CLARKE, Pal. New York, VIII, Pt. 1, p. 101; Eleventh Ann. Rept. State Geologist, p. 250.
1885. *Limmarssonia* WALCOTT, Amer. Jour. Sci., 3d ser., XXIX, p. 115.
1886. *Limmarssonia* MATTHEW, Trans. Roy. Soc. Canada, III, p. 35.
1889. *Limmarssonia* DAWSON, Trans. Roy. Soc. Canada, VII, p. 55, fig. 26.
1892. *Limmarssonia* HALL and CLARKE, Pal. New York, VIII, Pt. 1, 1892, p. 107; Eleventh Ann. Rept. N. Y. State Geologist, 1891, p. 251.
1892. *Limmarssonia* MATTHEW, Trans. Roy. Soc. Canada, II, p. 42.
1902. *Acrotreta* MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, IV, Pt. 5, pp. 390, 394.

Original description.—Dorsal valve highly conical; the hinge surface of this cone flat, in the form of a high triangle, similar to an area, with a shallow gutter-shaped depression running from the tip as far as the middle point, which [depression] here appears as an indication of a deltidium. At the upper end of this furrow, turned consequently to the hinge side, is found the obtusely oval external siphonal opening (I).

Ventral valve flat, with a distinct marginate apex. On the surface of the shell are seen only delicate growth wrinkles concentric to the apex of the cone, which curves crescentically into the longitudinal furrow of the surface of the shell; no tubercles and no spines; hinge border rectilinear.

Revised generic description.—Ventral (pedicle) valve conical, with the posterior face more or less flattened, and usually marked by a shallow groove. Foraminal opening at the apex of the cone and directed slightly backward. Area narrow, divided midway by the path of advance of a small false deltidium. Dorsal (brachial) valve slightly convex, with very small beak; area short and divided as in the pedicle valve by a small false deltidium. Surface marked by fine concentric striæ and lines of growth which cross the posterior face and the median groove. The shell in all species where it is preserved is calcareo-corneous, and built up of several thin layers of lamellæ that are arranged more or less obliquely to the outer surface toward the outer margin of the valves.

The cast of the pedicle valve shows that the interior of the shell had a rather strong callosity or apical swelling penetrated by the foraminal tube, and on each side of and back of the callosity near the posterior margin a small projecting boss or cardinal tubercle, which corresponds to a depression in the shell, on which the transmedian and middle lateral muscle were probably attached. In front of the apical callosity in *A. argenta* there are two trapezoidal areas corresponding to similar areas in *Obotella* and *Obolus*, in which the central, outside, and middle lateral muscles were attached. The position and size of the areas are shown by several specimens. The grooves of the main vascular sinuses pass around the apical swelling and extend forward, diverging toward the antero-lateral margins of the shell. The interior

of the brachial valve is almost invariably marked by a long, well-defined median ridge and a pair of strong cardinal tubercles near the margin of the area, corresponding in position to the cardinal tubercles of the pedicle valve. Smaller tubercles occur in advance of the posterior tubercles, one on each side of the median ridge. They are often replaced by elongate oval scars that correspond to the central scars of the dorsal valve of *Obolus*. The cardinal tubercles of both valves often have scars on them, indicating the attachment of the muscles.

Observations.—Of the type of the genus, *A. subconica*, only the external shell is known. In 1884 I illustrated the interior of the two valves of *A. gemma*,¹ showing the area of the median ridge, the "cardinal tubercles" and the central muscle tubercles of the dorsal valve, and the apical swelling and cast of the main vascular canals of the ventral valve. In 1886 Mr. G. F. Matthew illustrated the interior of *A. baileyi*,² showing the cast of a small tubercle on each side of the apical swelling. Messrs. Hall and Clarke write that they could not see the cast of these tubercles on the original specimen,³ and I have been unable to find them on the specimens that Dr. Matthew very kindly sent me as the types. The intimate relations existing between *Acrotreta* and *Linnarssonina* became more and more apparent as better material was obtained of the two species referred to the two genera. Dr. G. H. Girty, when selecting specimens for illustration, called my attention to the strong resemblance between them, and suggested that *Linnarssonina* was a synonym of *Acrotreta*. In all essential characters this is true, and *Linnarssonina*, if retained at all, must be as a subgenus to include the depressed forms of *Acrotreta* intermediate between the typical elevated species *A. subconica*, *A. gemma*, and the nearly flattened shells of *Acrothele*. In view, however, of the close similarity of the interiors of the valves of *Acrotreta schmalensei*, *A. curvata*, *A. kutorgai*, and *Linnarssonina transversa*, *L. sagittalis*, and *L. misera*, there remains only the external form of the pedicle valve to distinguish the two genera; this latter character is not of sufficient importance to base a subgenus on, in the presence of the series of gradation of elevation and outline between *A. subconica* and *A. transversa* shown by *A. idahoensis*, *A. schmalensei*, *A. microscopica*, *A. pyridicula*, *A. sagittalis*, and *A. transversa*.

When studying the specimens of *Acrotreta* at hand in 1884 I believed that *A. gemma* of Newfoundland included the western forms described by Messrs. Meek and White. This conclusion was retained until the study of a large series from each of the typical localities convinced me

¹Mong. U. S. Geol. Sur., VIII, pl. 1, figs. 1b, 1d.

²Trans. Roy. Soc. Canada, III, pl. v, figs. 13, 13c.

³Pal. New York, VIII, Pt. 1, p. 102.

that there were a number of species and varieties grouped under *A. gemma*. The species referred to the genus at present are:

Species at present referred to Acrotreta.

	Cambrian.			Ord.	Locality.
	L.	M.	U.		
<i>Acrotreta</i>					
<i>argenta</i> , new species.....			✓		Nevada.
<i>attenuata</i> Meek.....					Montana, Wyoming.
<i>babeli</i> Barrande.....				×	Bohemia.
<i>baillyi</i> Matthew.....		×			New Brunswick.
<i>belti</i> Davidson.....				×	Wales.
<i>bisecta</i> Matthew.....			×		Nova Scotia.
<i>claytoni</i> , new species.....	×				Nevada.
<i>concentrica</i> , new species.....		×			Georgia.
<i>conula</i> , new species.....			×		Sweden.
<i>convexa</i> , new species.....			×		Nova Scotia.
<i>curvata</i> , new species.....			×		Nevada.
<i>definita</i> , new species.....		×			Do.
<i>depressa</i> Walcott.....					British Columbia.
<i>gemma</i> Billings.....				×	Newfoundland.
<i>gemma</i> Matthew.....			✓		New Brunswick.
<i>gracia</i> , new species.....					Do.
<i>idahoensis</i> , new species.....		×			Idaho, South Dakota, Wyoming.
<i>idahoensis alta</i> , new variety.....					Nevada.
<i>idahoensis sulcata</i> , new variety.....					Idaho.
<i>inflata</i> Matthew.....			✓		New Brunswick.
<i>kutorgai</i> , new species.....					Alabama.
<i>microscopica</i> Shumard.....					Texas, Nevada.
<i>microscopica missouriensis</i> , new variety.....			✓		Missouri.
<i>microscopica tetonensis</i> , new variety.....		×			Wyoming.
<i>minimus</i> Barrande.....					Bohemia.
<i>miser</i> Billings.....			×		Newfoundland, New Brunswick.
<i>nicholsoni</i> Davidson.....				✓	Scotland.
<i>ophirensis</i> , new species.....					Utah.
<i>ophirensis rugosus</i> , new variety.....					
<i>oralis</i> , new species.....					Quebec.
<i>pareula</i> Wallerius.....			✓		Sweden.
<i>primæva</i> , new species.....		×			Nevada.
<i>pyridicula</i> White.....				×	Idaho, Montana, Nevada.
<i>subline</i> Calloway.....				✓	England.
<i>sagittalis</i> Salter.....					North and South Wales, Sweden, Denmark, Newfoundland, Quebec.
<i>sagittalis magna</i> Matthew.....			×		New Brunswick.
<i>sagittalis taconica</i> Walcott.....		×			New York.
<i>sagittalis transversa</i> Hartt.....			×		New Brunswick and Newfoundland.
<i>schaulenski</i> , new species.....			✓		Sweden, Denmark.
<i>seebachi</i> , new species.....				×	Norway.
<i>signalis</i> , new species.....			×		Wisconsin.
<i>socialis</i> v. Seebach.....			×		Sweden.
<i>subconica</i> Kutorga.....					

ACROTRETA ARGENTA, new species.

The material representing this species is more or less crushed and broken in the shaly sandstone and limestone, but a few specimens show its general form and characters. It belongs to the *A. idahoensis* group in having a wide false area, strongly marked apical callosity, and foraminal tube. The thickening in the posterior portion of the brachial valve is also characteristic of the two species.

The cast of an interior of the pedicle valve reveals what I have searched for unsuccessfully in hundreds, if not thousands, of specimens of this genus. I refer to the visceral area with the position of the point of attachment of the central and lateral muscles on each side of it, essentially as in *Obolella* and *Obolus*.

Formation and locality.—Upper Cambrian, 2 miles southeast and 1 mile southwest of summit of Benders Pass, Silver Peak Range, Nevada. F. B. Weeks, collector, 1900.

ACROTRETA BAILEYI Matthew.

Acrotreta baileyi MATTHEW, Trans. Roy. Soc. Canada, III, 1886, p. 36, pl. v, fig. 13.—HALL and CLARKE, Pal. New York, VIII, 1892, Pt. 1, p. 102, pl. III, figs. 32-34.—MATTHEW?, Trans. Roy. Soc. Canada, IX, 1892, p. 43, pl. XII, fig. 7d. Referred to *A. bisecta*.

Acrotreta bisecta MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, IV, 1902, Pt. 5, p. 395, pl. XVI, figs. 1, 1a-d.

General outline transversely oval, with the posterior margin more or less straight for less than one-half the transverse diameter of the shell. On the pedicle valve the posterior margin is rounded in at the median furrow of the false area, and on the brachial valve it curves gently from the cardinal slopes to the beak.

The pedicle valve is strongly convex, with the apex about one-fourth the length of the valve from the posterior margin. The crushed condition of the shells does not permit of decision as to whether the umbo or the apex is the most elevated part of the valve. False area defined by the incurving of the cardinal slopes so as to form a somewhat flattened triangular space that is divided midway by a rather strong vertical furrow. Foraminal aperture rather large and opening obliquely backward. The brachial valve is gently convex, with a minute marginal beak.

Surface of shell marked by fine concentric striae and lines of growth, and possibly by fine radiating striae. I fail to find any traces of the radiating striae on specimens that have not been distorted by pressure, and it looks as though all radiating striae and lines are the result of lateral compression of the shell. The average length is about 3.5 mm. and the width 4 mm. Distorted shells give a length of 4 mm. and a width of 3 mm.

The cast of the interior of the pedicle valve shows a strong apical callosity, a fair-sized foraminal tube, large cardinal scars, and a small visceral area in front of the apical callosity. Dr. G. F. Matthew describes and shows on his illustration two "minute muscular scars" close to the "umbonal tubercle" and on each side of the parallel striae.¹ I find on one specimen what may have led Dr. Matthew to believe there were such scars, but on many others quite as well preserved there were none such, and they are not known in any other species of the genus. Messrs. Hall and Clarke examined Dr. Matthew's type material, and say that with the original material before them they were unable "to distinguish anything more than the central callosity."²

¹ Trans. Roy. Soc. Canada, III, p. 36, pl. v, fig. 13c.

² Pal. New York, VIII, Pt. 1, 1892, p. 102.

The cast of the interior of the brachial valve shows a strong median ridge of variable length and size, large cardinal scars, and well-defined central scars.

Observations.—This species belongs with the series represented by *A. sagittalis* and its varieties, and if uncompressed, nondistorted, well-preserved specimens could be obtained, it is quite possible that it would prove to be identical with *A. sagittalis transversa*. Dr. Matthew thinks it had a thinner shell; but that is not probable, as the apical callosity and cardinal scars of the pedicle valve, and the median ridge, cardinal and central scars of the brachial valve all indicate a shell quite as thick as that of *A. sagittalis* and varieties.

Dr. G. F. Matthew kindly sent me the type and study material of this species from his private collection.

Formation and locality.—Middle Cambrian, Long Reach, Kings County, New Brunswick.

ACROTRETA BISECTA Matthew.

Acrotreta baileyi MATTHEW?, Trans. Roy. Soc. Canada, IX, 1892, p. 43, pl. XII, fig. 7d.

Acrotreta bisecta MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, IV, 1900, p. 275, pl. v, figs. 5a-g; IV, Pt. 5, 1902, p. 394, pl. XVI, figs. 2, 2a-g.

Nearly all the pedicle valves of this species are more or less compressed in the shale, thus decreasing the true elevation. Mr. Matthew illustrates a pointed high pedicle valve, but does not say whether the figure is diagrammatic. Some of the casts in the shale indicate a sharply conical pedicle valve. When the apex is broken off, the cast of a medium apical callosity is seen, with the base of the cast of a medium-sized pyramidal tube; the cardinal scars are small and nearly concealed by the cast of the strong main vascular sinuses. There is considerable range of variation in the size and length of the median ridge of the brachial valve. One specimen shows a strong median ridge, cardinal and central scars, and deeply excavated false deltidium.

Surface marked by fine concentric striae and lines of growth and very fine undulating striae that give the concentric striae a fretted appearance when examined with a strong lens.

The most nearly related species appears to be *A. sabrinae* of the Shineton shales.

Formation and locality.—Upper Cambrian, Barrachois Glen, 4 miles south of Little Bras D'Or Lake. Mr. Matthew's types came from McLeod Brook, Cape Breton, Nova Scotia, and he also identifies it from Div. C, 3c, at Navy Island, St. John Harbor, New Brunswick. Mr. S. Ward Loper found many specimens of several horizons in the shales on both sides of Barrachois River, near the Boisdale road, and for some distance north; also on the east branch of the Barrachois River, Cape Breton, Nova Scotia.

ACROTRETA CLAYTONI, new species.

The material representing this species does not give sufficient data to prepare a detailed description. The only pedicle valve is depressed by compression in the shale; it is transversely broad oval in outline, with the posterior margin nearly straight for a distance of two-fifths of the diameter of the valve; the false area fairly well defined by the abrupt incurving of the cardinal slopes; its median furrow is distinctly outlined, and it slopes forward to the apex, which is situated about two-fifths the distance from the posterior margin to the front margin. Foraminal aperture minute and directed upward from the extreme apex of the valve. Brachial valve gently convex. Surface of shell marked by fine concentric striae and lines of growth, and very fine, irregular, undulating striae that can be seen only by the aid of a strong lens.

A partial cast of a brachial valve from the same faunal horizon, about 30 miles distant, shows a well-defined median ridge and cardinal scars.

This species is most nearly related to *A. primæra* of the upper *Olenellus* fauna, at Pioche, Nevada. It differs in having a less elevated pedicle valve and the most advanced position of the apex and foraminal aperture. All the five specimens known are also smaller than the average of *A. primæra*, the largest being 3 mm. in width and 2.5 mm. in length.

Formation and locality.—Lower Cambrian shales, with *Olenellus*, on the divide between Clayton and Fish Lake valleys, north of Red Mountain, Silver Peak Range; also, 2 to 5 miles south of Barrel Spring and one-half mile east of road as shown on the map of the Silver Peak quadrangle, Nevada.

ACROTRETA CONCENTRICA, new species.

Shell small, outline subcircular to transversely broad oval; apex of pedicle valve nearly concentric; false area indicated by a slight flattening of the valve on the posterior side and a distinctly marked but very narrow median furrow. The elevation of the valve is about one-half its diameter. The brachial valve is slightly convex, and its cast is marked by small cardinal scars and a narrow median ridge that extends to the anterior third of the shell. A pedicle valve is 1.25 mm. in diameter, and one brachial valve is 2 mm. in length.

This species occurs at about the horizon of *A. kutorgai*, but is distinguished from that species and all others by the concentric position of the apex of the pedicle valve.

Formation and locality.—Middle Cambrian, shaly limestones on roadside between Dalton and Lafayette, Georgia.

ACROTRETA CONULA, new species.

Shell small. Pedicle valve excentrically cone-shaped, with a broadly ovate transverse aperture. The apex is situated at the posterior fourth of the distance between the front margin and the posterior edge of the slightly indicated false area. A minute pedicle aperture occurs at the summit of the apex. Brachial valve convex with the minute beak at the posterior margin. The cast shows a well-defined median ridge with the central muscle scars well back on the valve.

Surface marked by fine concentric striae and lines of growth.

Formation and locality.—Upper Cambrian, *Olenus truncatus* zone, Oland, Sweden.

ACROTRETA CONVEXA, new species.

Shell small, subcircular, valves convex. Pedicle valve most elevated at the low apex which is above the slightly transverse posterior margin. Brachial valve somewhat less convex than the pedicle valve, with its greatest elevation at the posterior third beak, minute, marginal. Length and width of shell 1 mm. Shell substance very thin but not proportionally thinner than other larger forms. Surface marked by fine concentric striae and lines of growth.

Casts of the interior of the pedicle valve show a minute apical callosity and cardinal scars. The cast of the brachial valve has a long median furrow and minute cardinal scars.

This minute shell occurs in a fine-grained sandstone interbedded in the shales of the Upper Cambrian. It is characterized mainly by the convexity of the brachial valve and the low pedicle valve.

Formation and locality.—Upper Cambrian, Gillis Hill, Salmon River, 13 miles south of Marion Bridge, Cape Breton, Nova Scotia. Collected by Mr. S. Ward Loper.

ACROTRETA CURVATA, new species.

This is one of the so clearly defined species that it is possible to illustrate all that is known of it with the exception of the very fine concentric surface striae. It belongs with *A. idahoensis* and other species with a broad false area. It differs from described species in the incurved apex of the pedicle valve and the general aspect of the two valves.

Formation and locality.—Upper Cambrian, passage beds between Cambrian and Ordovician near base of Pogonip limestone, Hamburgh Ridge, Eureka District, Nevada.

ACROTRETA DEFINITA, new species.

The false pedicle groove is very distinct and also broader than that of *A. attenuata*. The interior of the pedicle valve is beautifully shown by casts. One of these shows the strong vascular sinuses, cardinal

sears, east of apical callosity, and just in front of the latter two slight tubercles which may be the east of depressions corresponding to the foraminal pits of *Acrothole*. The east of the brachial valve is also very instructive in showing the area, cardinal sears, median ridge, and central sears.

Observations.—This large fine species differs from its nearest ally, *A. idahoensis*, in the false area and the details of the arrangement of the vascular markings and muscle sears of the interior of the valves. The Idaho shells occur in a dark argillaceous shale and were collected by Mr. Spence, of Paris, Idaho. The Eureka, Nevada, specimens are from a shaly limestone.

Formation and locality.—Middle Cambrian, near Montpelier, Idaho; summit of Prospect Mountain limestone, Prospect Mountain, Eureka District, Nevada.

ACROTRETA GEMMA Billings.

Acrotreta gemma BILLINGS, Pal. Foss., I. 1865, p. 216, figs. 201a-f.

Original description.—Shell very small, about 1 line in diameter; one valve nearly flat and the other acutely conical. Dorsal valve very gently convex, nearly circular; sides and front margin uniformly rounded; posterior margin very obtusely angulated at the beak, on each side of which a portion of the cardinal edge, equal to one-fourth of the whole width of the shell, is nearly straight; umbo very small; beak apparently depressed to the hinge line and not projecting beyond it; cardinal angles compressed, broadly rounded; a wide, shallow, mesial sinus extends from the front margin about halfway to the beak; elsewhere the valve is gently convex or nearly flat.

Ventral valve acutely conical, with a flat triangular area which is perpendicular to the plane of the lateral margin, its base half the width of the whole shell. In the apex of this valve there is a minute circular aperture, and in one specimen a dark line extends from it down the middle of the area, which appears to represent the foraminal groove of this genus; but in two other specimens of the ventral valve, with the area well preserved, there is no indication of a groove. Surface with very fine concentric striae.

Width of dorsal valve, about 1 line; length, about seven-eighths of a line. The height of the ventral valve is about 1 line.

The form of this species is very like that of *A. subconica* (Kutorga), but that species is twice the size of this and has the area distinctly grooved.

Observations.—By the courtesy of Prof. J. F. Whiteaves, of the Geological Survey of Canada, I have had the opportunity of studying the type material of this species. Nine specimens of the pedicle valve were received, but none of the brachial valve, as they could not be found. One specimen in a dove-colored limestone appears to belong to a distinct species, which I have named *Acrotreta ovalis*. The remaining specimens show some variation in the angle of slope of the sides of the pedicle valve, but four of them are similar to the form illustrated by Billings.

The broad false area with a scarcely perceptible impression of the path of advance of the pseudodeltidium is clearly shown in one of the

specimens, and faintly in others. Two shells have the apex broken off so as to expose the cast of a minute apical callosity and a small portion of the side of the cast of the main vascular sinus.

A. gemma belongs to the *A. subconica* group of the genus, having a high pedicle valve and distinct and broad false area. It differs from *A. subconica* in having a less elevated pedicle valve and in the apex being in front of the posterior margin instead of extending over it. With the forms from the Rocky Mountains that I identified with it there are no strong specific relations. *A. attenuata* has a high pedicle valve, but the false area is practically absent, a narrow deep sulcus taking its place. *A. idahoensis alta* has the elevation and false area, but differs in the details of the area and the outline of the cross section of the pedicle valve. It was this form that led me to consider that *A. gemma* occurred in Nevada, and with the slight knowledge that I then had of the genus and species a wide range of form was given to *A. gemma*. As far as now known to me, the species is restricted to the type locality.

Formation and locality.—Lower Ordovician, limestone, North Table Head and Pistolet Bay; limestone point 4 miles northeast of Portland Creek, Newfoundland.

ACROTRETA GRACIA, new species.

Shell small, slightly transverse; apex of pedicle valve about one-third the length of the shell from the posterior margin; height about two-thirds the length of the shell; false area defined by the sharp rounding of the cardinal slopes and the transverse posterior margin, which is indented by the strong, broad, median groove extending from the margin to the apex, where it almost comes in contact with the minute apical foramen. Brachial valve moderately convex, with a nearly straight or gently curved posterior margin; beak minute, marginal. Surface of shell marked by fine concentric striae and lines of growth. Shell strong, and built up of thin layers or lamellae that over the central and anterior portions are more or less oblique to the outer surface layer.

The cast of the pedicle valve indicates a small but very clearly marked apical callosity; rather small cardinal scars and main vascular sinuses. The cast of the interior of the brachial valve shows a broad, low, median ridge extending to about the anterior third of the length of the valve; small cardinal scars and small main vascular sinuses that arch inward after passing the central scars, and then outward. The area is very narrow, and broken midway by a rather wide, slightly arching false deltidium.

This species is distinguished by the strong shell, broad median ridge of the brachial valve, and deep median groove of the false area of the pedicle valve. The light color of the shell may be owing to the char-

acter of the limestone in which it is preserved, or it may be that it is a little more calcareous than other species of the genus.

Dr. G. F. Matthew describes and illustrates an *Acrotreta* from Hastings Cove as *Linnarssonia belti magna* that is characterized by a narrow median ridge in the brachial valve and other characters not present in *A. gracia*. I found on Hanford Brook in the *Paradoxides* zone numerous examples of a species of *Acrotreta* that appear to be identical with the form described by Mr. Matthew, and have referred it as a variety of *Acrotreta sagittalis*.

Formation and locality.—Middle Cambrian, *Paradoxides* zone, Hastings Cove, Kennebecasis River, St. John County, New Brunswick.

ACROTRETA IDAHOENSIS, new species.

Acrotreta subconica MEEK, Sixth Ann. Rept. U. S. Geol. Sur. Terr., 1873, p. 463.
Not Kutorga, 1847.

The general outline, form, and convexity of the two valves are so fully shown by the illustrations for the monograph that detailed descriptions will not be given. The material for illustrating the interior of the pedicle valve is limited, but one cast shows the position of the base of the cast of the foraminal tube and the large main vascular sinuses. An interior of abrachial valve presents characters rarely seen in this genus. The vascular canals arch out around the central muscle scars and then bend in toward the median ridge, and again obliquely outward to form the outer limit of a smooth, polished, lanceolate-shaped surface that extends obliquely outward from the median ridge. The line that extends from in front of the cardinal scars forward subparallel to the margin of the shell and then bends abruptly in and forward is apparently the outer boundary of a very broad, shallow, vascular sinus. Something of this same character occurs in the brachial valve of *Obolus* (*Lingulobolus*) *spissus*. The cardinal scars are small and situated close to the narrow area. A cast of the interior shows the central scars distinctly; also the presence of a thickening of the shell in the vicinity of the cardinal scars.

Observations.—The external characters of this species suggest *Acrotreta curvata*, but the elevation and curvature of the pedicle valve are not the same and the interior of the brachial valve is very distinct in its specific characters. There are no interiors of the form from the Black Hills, but the external characters appear to be the same. These include the broad false area, with its slightly marked groove, the position of the apex, and the curvature of the false area.

Formation and locality.—Middle Cambrian. Five miles southeast of Malad City, Idaho. Northwest suburb of Deadwood, Black Hills, South Dakota. South side of Gallatin Valley, in several sections of Flathead and Gallatin terranes; also Crowfoot section, Gallatin Range, Yellowstone National Park, Wyoming.

ACROTRETA IDAHOENSIS ALTA, new variety.

This is one of the forms that I included with *Acrotreta gemma* in the report on the paleontology of the Eureka District, Nevada. It has the broad false area of *A. idahoensis*, but the pedicle valve is more elevated and the apex does not overhang the false area. From *A. attenuata* it differs in having a broad false area.

Formation and locality.—Middle Cambrian, upper portion of Secret Canyon shales, Secret and New York canyons, Eureka District, Nevada.

ACROTRETA IDAHOENSIS SULCATA, new variety.

This strongly marked pedicle valve is associated with typical forms of the species, but in its rounded posterior side and strong median groove it is quite distinct. The apex is broken off so as to show the cast of a small apical callosity and the base of a minute foraminal tube.

Formation and locality.—Middle Cambrian, near Paris, Idaho. Collected by Mr. Spence.

ACROTRETA INFLATA Matthew.

Lingulella? inflata MATTHEW, Trans. Roy. Soc. Canada, III, 1886, p. 33, pl. v, figs. 7, 7a; Trans. N. Y. Acad. Sci., XIV, 1895, p. 127, pl. v, fig. 3.

Lingulella? inflata var. *oralis* MATTHEW, Trans. N. Y. Acad. Sci., XIV, 1895, p. 127, pl. v, fig. 4.

Acrothyra? inflata MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, IV, 1901, p. 303.

Lingulella (Acrothyra?) inflata MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, IV, 1902, Pt. 5, p. 390.

Shell subcircular to transversely broad oval. Pedicle valve subconical, with the apex directed backward and usually on a line with the posterior margin, or extending beyond it, but it may be anterior to it; false area slightly defined by the abrupt curvature of the cardinal slopes; median line depressed, narrow, the two sides of the false area incurving to form to it; foraminal aperture longitudinally oval and slightly truncating the apex. Brachial valve gently convex, with a minute marginal beak. Surface of shell marked by concentric striae and growth lines, and fine, irregular, wavy striae that inosculate more or less, giving the surface a fretted appearance under a strong lens. The inner surface is marked by concentric lines, also rather strong radiating lines. The shell is built up of the thin, outer, ornamented surface and several thin inner layers or lamellæ. The average length of the pedicle valve is 4 mm. and the width 3 to 3.5 mm. The brachial valves are usually wider than long.

Casts of the interior of the pedicle valve show strong cardinal scars, a strong apical callosity, and rather weakly developed main vascular sinuses. The apical callosity varies in size and in form from elongate oval to subcircular. The cast of the interior of the brachial valve

shows a broad, short median ridge posteriorly that extends beyond the center of the valve.

Observations.—This species appears to be a true *Acrotreta* with the apical callosity elongated by the elongation of the pedicle valve. The brachial valve is more convex than in most species of *Acrotreta*, which gives a stronger relief to the ridges on the cast between the cardinal scars and the median ridge. The posterior view should be compared with the same view of the brachial valve of *Acrotreta sagittalis* and its varieties. The fretted surface is of the same type as that of several other species of the genus.

Dr. G. F. Matthew had very little material when he described the species; subsequently he created the variety *oralis*, from a more elongated pedicle valve. In the collection made for the U. S. National Museum by Mr. S. Ward Loper there are a number of pedicle and brachial valves. The range of variation in outline appears to cover the variety *oralis*. Some are more transverse than the original type of the species, and others nearly as elongate as the variety *oralis*. I have therefore considered the variety as within the original species. Some of the shells show elongation, and others are broadened by distortion.

Dr. G. F. Matthew called attention to the resemblance of this species to *Linnaarssonia* and *Acrotreta*, and when describing the genus *Acrothyra* suggested that it might belong to that genus. It appears, however, to be a true *Acrotreta*. A series of specimens supplemented by the types and a number of pedicle valves received from Dr. Matthew, which he had provisionally identified as "*Acrotreta genuina* Bill¹," show a rather remarkable variation in outline and position of the apex of the pedicle valve. The narrow forms, var. *oralis* Matthew, have the apex extended beyond the posterior margin, and in the broad forms the apex is above or in advance of the posterior margin, but if the shells are compressed vertically the apex may be pushed out over the false area whether the shell be narrow or broad. I think that in the normal form the false area is vertical or slightly inclined backward.

Formation and locality.—Middle Cambrian, division 1b of Matthew's section, Hanford Brook, New Brunswick.

ACROTRETA KUTORGAI, new species.

The external characters of the pedicle valve are clearly exhibited, and what is known of the interior, by a unique specimen, as it is the only one known to me that clearly shows the true area and pseudo-deltidium of the pedicle valve. The corresponding portion of the brachial valve is well defined in the casts. The median ridge is as long proportionally as that of *A. bisecta*, and, like it, varies in length and size in different shells.

¹Trans. N. Y. Acad. Sci., XIV, 1895, p. 126.

The outer surface is marked by fine concentric striae and lines of growth.

Observations.—This pretty species occurs attached to the surface of siliceous nodules in association with *Olenoides curticei*, *Crepicephalus teranus*, *Acrothele bellula*, and casts of *Medusa*. The outline of the convexity of the valves and the posterior view of the pedicle valve is most like that of *A. attenuata*, but the interior markings are quite unlike.

Formation and locality.—Middle Cambrian. Siliceous nodules in Coosa shales, Coosa Valley, 3 miles south of Gadsden, and near Chepultepec on road near Wades Gap, Alabama. Rogersville shale, Rogersville, and north and south of the town, Tennessee.

ACROTRETA MICROSCOPICA MISSOURIENSIS, new variety.

The shell is uniformly larger than the Texas shells and the vertical median line of the false area is more depressed and distinct. Some of the specimens of the pedicle valves beautifully illustrate the effects of compression. One shell is like that of *Acrotreta attenuata*, and another resembles the low form of *A. ophirensis* with the apex overhanging the false area. The surface of the shells embedded in a very fine-grained sandstone has a papillose surface resulting from the indenting of the shell by the grains of sand, while those from limestone are marked only by fine concentric striae.

Formation and locality.—Middle Cambrian, in sandstones of the conglomerate series, St. Francois County, and in thin-bedded limestones south-southwest of Potosi, Missouri.

ACROTRETA MICROSCOPICA TETONENSIS, new variety.

This neat little shell possesses the characters of *A. microscopica* and *A. idahoensis*, but differs from both by the projection of the apex of the pedicle valve over the false area. All that is known of it is represented by the illustrations for the monograph.

Formation and locality.—Middle Cambrian, divide at head of Sheep Creek, north end of Teton Range, Wyoming.

ACROTRETA MISER Billings.

Obolella ? miser BILLINGS, Can. Nat. and Geol., new ser., VI, 1872, p. 470; Pal. Foss., II, 1874, Pt. 1, p. 69.

Linnarssonia misera MATTHEW, Trans. Roy. Soc. Can., III, 1886, p. 35, fig. 12.—HALL and CLARKE, Pal. N. Y., VIII, 1892, Pt. 1, p. 108, pl. VIII, figs. 35–37.

The abundant material that I collected of this species in Newfoundland gives illustrations that present its characters with such fullness and detail that minute description is unnecessary. Numerous figures of the pedicle valve show variation in outline, also of the cast of the apical callosity, cardinal scars, and base of main vascular sinuses. Others well illustrate the interior of the brachial valve.

The outer surface is marked by fine concentric striae and growth lines, and the inner layers or lamellae by very fine radiating striae. The minute foraminal aperture is on the back side of the apex, opening almost posteriorly in some examples.

This is a small species averaging from 1.5 to 2.5 mm. in length. It occurs in immense numbers in limestone lentiles of the *Paradoxides darisi* zone of Newfoundland. It is also very abundant at Hastings Cove.

Formation and locality.—Middle Cambrian, paradoxides zone, Chapel Arm, Trinity Bay; Manuels Brook, Avalon Peninsula, Newfoundland; Hastings Cove, Kennebecasis River, and Dr. G. F. Matthew identified it at Porters Brook, St. Martins, St. John County, New Brunswick.

ACROTRETA OPHIRENSIS, new species.

General outline transversely broad oval, sometimes nearly circular, with the posterior margin slightly indented midway on the pedicle valve by incurving to the false pedicle furrow. The pedicle valve is convex and moderately elevated, the highest point being in front of the foraminal aperture at about one-third the diameter of the shell. Foraminal aperture large for the size of the shell and opening either directly or obliquely backward. One specimen shows a short, narrow area, with a triangular false pedicle furrow crossing it; false area scarcely defined by the cardinal slopes, which incurve very gently; median furrow well defined, rather strong, and nearly flat on the bottom, the margins being sharply outlined in many specimens. The shell sometimes curves over the false area so that the depressed apex extends slightly beyond the posterior margin, but usually it is directly on the line of the posterior margin or a little in front of it. Longitudinal diameter of average size pedicle valve 3 mm., with a length of 2 mm. to 2.5 mm.; elevation 1.5 mm. A few shells have nearly the same length and width. The convexity of the brachial valve averages 0.75 mm. The minute beak of the brachial valve curves down to the posterior margin from the somewhat elevated posterior third of the valve.

Surface marked by fine concentric striae and marked lines of growth which occasionally form concentric ridges. The shell is built up of a thin outer layer and numerous thin inner layers or lamellae that are oblique to the outer layer over the central and outer portions, the obliquity increasing toward the outer anterior and lateral margins.

The interior of the pedicle valve shows a rather strong apical callosity that extends nearly to the posterior inner margin of the shell; distinct but relatively small cardinal scars, and narrow main vascular sinuses that may be traced nearly to the antero-lateral margins of the valve; the outlines of the visceral cavity are indicated on one well-

preserved east of the interior of the valve. The interior of the brachial valve shows great variation in the size and length of the median ridge, and cardinal and central scars. These characters are fully shown in the numerous illustrations of the interior and casts of the interior of the brachial valve.

Observations.—This species is most closely related to *Acrotreta curcata*. It differs in the pedicle valve being larger, in the apex being less extended over the false area, and in the form of the median furrow, which is like that of *A. alternata*. Although the shells occur in a compact, unaltered limestone, there is more or less distortion in the outline of both valves. This, taken in connection with the variations in form and size of the vascular markings, muscle scars, and median ridge of the brachial valve, might serve to discriminate several so-called varieties, but I do not think that any good purpose would be subserved thereby.

Formation and locality.—Middle Cambrian, in limestone above the basal quartzite, Ophir City, Utah.

ACROTRETA OPHIRENSIS RUGOSUS, new variety.

This form is associated with *A. ophirensis* in considerable numbers. It is characterized by strong, rugose growth lines and thicker shell.

ACROTRETA OVALIS, new species.

In the material representing *A. gemma* received from the Geological Survey of Canada there was one pedicle valve embedded in a smooth, dove-colored limestone from Point Levis. In the oval outline of the rim of the shell, less elevated apex, and less well-defined false area this specimen differs materially from *A. gemma*. It is more of the *A. socialis* type than any of the Atlantic province forms, and of *A. microscopica* of the interior continental species.

Formation and locality.—Lower Ordovician, Limestone No. 1 of Mr. Billings's Point Levis section, Province of Quebec, Canada.

ACROTRETA PARVULA Wallerius.

Obolella parvula WALLERIUS, 1895. Undersökningar öfver zonen med *Agnostus levigatus*. Vestergötland. Akad. Afhandl. Lund., p. 65, pl., fig. 9.

Shell minute, subcircular. Pedicle valve relatively depressed, the highest point being at the umbo, from which there is a slight downward curvature to the apex. False area low and about vertical, the apex being on a line with the posterior margin. Brachial valve slightly convex; beak marginal. Surface marked by fine concentric striae.

This minute species occurs with *Agnostus levigatus* in the upper portion of the Middle Cambrian. It is of the *Acrotreta sagittalis* type, but does not appear to be identical with the young of that species.

Formation and locality.—Middle Cambrian. Dark-brown limestone at Borgholm, Oland, Sweden, as collected by M. Schmalensee. Dr. Wallerius gives Gudhem and Djupadal, Vestergötland, Sweden.

ACROTRETA PRIMAÆA, new species.

Acrotreta gemma WALCOTT, Bull. U. S. Geol. Sur., No. 39, 1886, pp. 98, 99, pl. VIII, figs. 1, 1a, b.; Tenth Ann. Rept. U. S. Geol. Sur., 1891, p. 608, pl. LXVII, figs. 5c, 5d, 5e.

Outline of valves transversely oval to subcircular. Pedicle valve subconical, with the apex at the summit of the false area near to or just above the posterior margin. The elevation varies from one-half to two-thirds the diameter of the shell. The false area is quite clearly defined in most specimens; it varies in width at the posterior margin from one-third to nearly one-half of the diameter of the shell; the path of advance of the pseudodeltidium is marked usually by a narrow incised line similar to that of *A. attenuata*. Foraminal aperture minute and situated at the apex of the cone. Brachial valve slightly convex, with a minute beak slightly incurved over the posterior margin. A broad, slightly defined median sinus flattens the front and central portion of the valve, but it is not perceptible toward the umbo and beak. Surface of the shell marked by fine concentric striæ and occasional ridges of growth, and on some shells there is a very fine, almost microscopic irregular concentric striation that gives a fretted surface somewhat similar to that of *Obolus* (*Westonia*) *ella*. The inner lamellæ of the shell and the interior surface have traces of fine radiating striæ, that with the irregular concentric striæ give a broken, sub-imbriated, fretted effect to the surface. The shell is formed of a thin outer layer and several thin inner layers or lamellæ, the outer ones of which are slightly oblique to the outer surface layer. The largest shells have a transverse diameter of 5.5 mm., and a longitudinal diameter of 5 mm.; height of pedicle valve 3 mm.; brachial valve 1 mm. The interior of a slightly crushed pedicle valve shows the cast of an apical callosity, strong vascular canals, and faint outlines of the visceral cavity. The cast of an interior of a brachial valve has a long, well-defined median ridge, cardinal scars, and faintly defined central scars.

Observations.—This, the oldest species of the genus known to me, has all the essential characters of the type species, as far as the available information permits of comparison. It is one of the largest shells of the genus, and is a striking feature of the fauna of the higher portion of the *Olenellus* zone of Central Nevada. The nearest species appears to be *A. attenuata* var.

Formation and locality.—Lower Cambrian, upper portion of *Olenellus* zone, associated with fragments of *Olenellus gilberti* in thin layers of limestone interbedded in shales on east side of anticline just above quartzite, Pioche, Nevada.

ACROTRETA SAGITTALIS Salter.

- Obolella sagittalis* SALTER, Rep. Brit. Assn. Adv. Sci., for 1865, 1866, p. 285.
Discina labiosa SALTER, Rep. Brit. Assn. Adv. Sci., for 1865, 1866, p. 285.
Obolella sagittalis DAVIDSON, Geol. Mag., V, 1868, p. 309, pl. xv, figs. 17-24; Brit. Foss. Brach., III, 1871, p. 339, pl. L, figs. 1-14; V, 1883, Pt. 2, p. 211, pl. XVI, figs. 25, 26.
Obolella sagittalis LINNARSSON, Brach. Paradoxides Beds of Sweden. Bihang till k. Svenska vet. Akad. Handl., III, 1876, No. 12, p. 19, pl. III, figs. 36-41.
Linnarssonia sagittalis WALCOTT, Amer. Jour. Sci., 3d ser., XXIX, 1885, pp. 115, 116; Tenth Ann. Rept. U. S. Geol. Sur., 1891, p. 610, pl. LXVIII, figs. 2, 2a-d.
Obolella (Linnarssonia) pretiosa DAWSON, Trans. Roy. Soc. Canada, VII, 1889, p. 53, figs. 26, a, b, c.
Linnarssonia enf pretiosa HALL, Trans. Roy. Soc. Canada, VII, 1889, p. 55.
Linnarssonia pretiosa HALL and CLARKE, Pal. N. Y., VIII, 1892, Pt. 1, p. 109, pl. III, figs. 43, 44.

Although I have examined a large collection of this species, both from Wales and from Sweden, good exteriors of the valves have not been observed. The apex of the pedicle valve almost invariably remains in the matrix or the shell has been removed by solution. The convexity of the two valves is approximately the same, except that the pedicle valve is more elevated near the apex. The apex is situated a little in front of the posterior margin at the edge of the slightly defined false area which slopes forward at an angle of from 70° to 80° . The surface of the shell is marked by rather coarse concentric striae and often strong ridges of growth and very fine radiating striae on the interior layers. The shell is built up of thin layers or lamellae of a calcareo-conchoidal nature. The average size of specimens from St. Davids, Wales, is 2.5 mm.

The interior of the pedicle valve is shown by numerous casts. The apical callosity is usually large, as are also the cardinal scars. The visceral cavity is sometimes outlined in front of the callosity and between the clearly marked main vascular sinuses. Casts of the interior of the brachial valve show a remarkable range of variation in the length and size of the median ridge. Within the extremes of variation specific characters could be established.

The representatives of the species from Andrarum, Sweden, are usually smaller than the St. Davids shells, but otherwise appear to be identical. This species has had a varied experience at the hands of paleontologists. Dr. Davidson elaborately illustrated the casts of the interiors of the valves, and I copied some of his figures when preparing the description of the genus *Linnarssonia*. When in Wales in 1888, I collected a quantity of material at St. Davids, and recently Mr. Schmalensee collected a good series at Andrarum for the U. S. National Museum. From these collections a series of figures have been drawn that illustrate the appearance of the shells as they occur both in shale and in limestone.

The varieties *tuonica* and *transversa* are strongly marked, but I think are not entitled to full specific valuation.

A direct comparison of specimens from the black shales of Little Metis with those from the black shales of the type locality of *A. sagittalis* at St. Davids fails to disclose any specific differences between them, as far as the material at hand permits of comparison. The Little Metis shell was identified with "*Obolella-Acrothele*" *pretiosa* by Prof. James Hall, and this identification was accepted by Sir William Dawson. "*Obolella*" *pretiosa* is a true *Acrothele*, and no species of *Acrotreta* is known to occur at the type locality on the Chaudiere River. The stratigraphic horizon of the Little Metis beds has not been definitely determined. Sir William Dawson says, "At Metis the evidence of the pebbles in the conglomerates indicates that they are newer than the Lower Cambrian, and the few fossils found in the sandstones and shales would tend to place them at or near the base of the Lewis division, or approximately on the horizon of the Chazy.¹ I personally examined the section at Little Metis in 1899, and am not at all certain of the horizon of the shales carrying *Acrotreta sagittalis* and the beautiful fossil sponges described by Sir William Dawson. It is a region of strong folding and thrust faults. The *Acrotreta* is a Middle Cambrian type, and nothing similar to it is known from the Upper Cambrian. As far as this shell can locate the horizon it is Cambrian, and probably low down in the Upper Cambrian.

Formation and localities.—Middle Cambrian, *Paradoxides* zone, Menevian, St. Davids, South Wales; near Dolgelly, North Wales. See Davidson for local distribution in the Menevian. Limestones of *Paradoxides forchhammeri* beds, Andrarum, Lovened Djupadalen Vestergotland, Sweden. Borregard Bornholm, Denmark. Limestone with *Paradoxides davisi*, Seal Point Cove, near Long Point, Trinity Bay, Newfoundland. Black shales of Little Metis, Province of Quebec, Canada, in association with fossil sponges described by Sir William Dawson. Probable horizon between the Middle and Upper Cambrian.

ACROTRETA SAGITTALIS MAGNA Matthew.

Linnarssonella belli DAVIDSON mut. *magna* MATTHEW, Trans. Roy. Soc. Canada, 2d ser., III, 1897, p. 169, pl. 1, figs. 1a, 1b.

In addition to the material collected by Dr. G. F. Matthew I have a number of specimens collected by me at the typical locality. A comparison with a series of specimens of *A. sagittalis* from St. Davids, Wales, and of *A. sagittalis transversa*, shows at once that the form Dr. Matthew named is very closely related to both. The length and size of the median ridge, the position of the central scars of the brachial valve, and the size and position of the cardinal scars of the pedicle valve are the internal characters that Dr. Matthew depends upon to

¹ Trans. Roy. Soc. Canada, VII, 1889, p. 32.

distinguish the variety *magna*. All of the characters are fully covered by the variations in the same characters in *A. sagittalis* and its variety *transversa*. The nearly circular form of variety *magna* is about the only character that can be considered of value, and that is very closely approached by some specimens of *A. sagittalis*.

Dr. Matthew's making his shell a variety of the variety *belti* (*Acrotreta sagittalis beltii*) is not altogether desirable, and it is not probable that the Lower Tremadoc shell *beltii* is a variety of *A. sagittalis*, and still less so that the New Brunswick shell is a variety of *Acrotreta beltii*. In order to have all the data possible for the student, I have illustrated Dr. Matthew's types, which he kindly sent me for the purpose; also specimens I found at Hastings Cove.

Formation and locality.—Middle Cambrian, *Paradoxides* zone, Hastings Cove, Kennebecasis River, St. John County, New Brunswick.

ACROTRETA SAGITTALIS TRANSVERSA Hartt.

Obolella transversa HARTT, Dawson, 1868; *Acadian Geology*, 2d ed., p. 614.—

WALCOTT, Bull. U. S. Geol. Sur., No. 10, p. 16, 1884, pl. i, fig. 5.

Limmarssonia transversa WALCOTT, Am. Journ. Sci., 3d ser., XXIX, 1885, p. 116,

figs. 3, 46.—MATTHEW, Trans. Roy. Soc. Can., III, 1886, p. 35, pl. v, fig. 11.—

HALL and CLARKE, Pal. N. Y., VIII, 1892, Pt. 1, p. 108, pl. III, figs. 38-42.—

MATTHEW, Trans. N. Y. Acad. Sci., XIV, 1895, p. 125, pl. v, figs. 1, 2.

Limmarssonia sagittalis var. *transversa* WALCOTT, Tenth Ann. Rept., U. S. Geol. Sur., 1891, description of pl. LXVIII, fig. 2a.

This is the representative of *A. sagittalis* in the *Paradoxides* zone of New Brunswick. Many shells are more transverse in outline than the average of *A. sagittalis*, but examples of the latter are nearly as much so, and the interior casts show a striking similarity in the Welsh and Acadian forms. The range of variation in each form is nearly if not quite as great as the variation between the two. In view of this, I think it best to characterize *transversa* as a variety of *A. sagittalis*.

Formation and locality.—Middle Cambrian, *Paradoxides* zone, division b, c², and d, St. John, Hanford Brook, New Brunswick; *Paradoxides darvisi* zone, Mannels Brook section, Avalon Peninsula, Newfoundland.

ACROTRETA SAGITTALIS TACONICA Walcott.

Limmarssonia taconica WALCOTT, Am. Jour. Sci., 3d ser., XXXIV, 1887, p. 189, pl. i, figs. 18, 18a-d.

Limmarssonia sagittalis var. *taconica* WALCOTT, Am. Jour. Sci., 3d ser., XXXVIII, 1889, p. 36; 1891; Tenth Ann. Rept. U. S. Geol. Sur., p. 610, pl. LXVIII, 1, 1a-d.

This variety is characterized by the uniformly shorter median ridge of the dorsal valve. The pedicle valves appear to be identical with those of *A. sagittalis* from Andrarum, which are embedded in the same character of matrix as the variety *taconica*.

This is the second species found in association with *Olenellus*. *A.*

primæva occurs in the upper zone of the *Olenellus* fauna in Nevada, and this is in the upper portion of the same fauna in the Appalachian region. Its association with *Microdiscus connexus*, a representative of *Microdiscus punctatus*, of the *Paradoxides* zone of New Brunswick, also serves to connect it with *Acrotreta sagittalis*. It appears to be one of the few forms that serve to connect the Cambrian fauna of the Atlantic province with that of the Appalachian province.

Formation and localities.—Upper portion of Lower Cambrian. Limestone interbedded in shaly slates. Rock Hill schoolhouse, near North Greenwich; $1\frac{1}{2}$ miles east, also west of North Greenwich; west summit of Bald Mountain, in the town of Greenwich; 2 miles south of North Granville; on the roadside just west of Low Hampton crossing of the Poultney River; one mile south of Shushan, one mile east of Salem, northeast section of Whitehall Township on SSW. road from Low Hampton—all in Washington County; Schodack Landing, Kinderhook Creek below paper mill at Stockport, Rensselaer County; near Valatie Creek near line of Nassau and Schodack townships, Columbia County, New York.

ACROTRETA SCHMALENSEI, new species.

Acrotreta socialis LINNARSSON, Brach. Paradoxides Beds of Sweden. Bihang till K. Svenska vet akad. Handl., III, 1876, No. 12, p. 16, pl. III, figs. 32-35.—WALLERIUS, Undersökningar öfver zonen med *Agnostus levigatus* i Västergötland. Akad. Afhandl. Lund, 1895, p. 66.

As in the case of many other species of this genus, the student is referred to the series of figures illustrating it for information as to the external outline, form, and convexity of the two valves and the range of known variation. The collections of the U. S. National Museum contain a large series of specimens, from which the shells illustrated were selected.

The broad false area has a shallow, faint median groove on some specimens, and on others no traces of it have been seen. The foraminiferal aperture, which is exceedingly minute, is situated at the extreme apex of the pedicle valve; the cast of the base of the foraminiferal tube is clearly shown in interior casts of the valve. One of the distinguishing characters is the cast of the large main vascular sinuses on each side of the visceral area. The casts of the interior of the brachial valve are interesting and instructive in showing the considerable variation in the size and length of the median ridge and the size of the cardinal and central scars.

The shell is small and is built up of a thin outer layer and several inner layers as lamellæ more or less oblique to the outer layer. The outer surface is marked by fine concentric striæ and lines of growth, and the inner surfaces of the lamellæ by concentric striæ and fine radiating striæ. The average length of the opening of the valves is 1.5 to 2 mm., and the width is usually a little more.

All of the specimens illustrated are from the *Paradoxides forchhammeri* zone. They appear to be identical with the figures of *A. socialis* of Dr. Linnarsson, but not of Dr. v. Seebach. Those of the latter represent a shell with strong concentric striae and median groove on the false area, characters that Dr. Linnarsson says he did not find on his specimens. Among the collections made for me by Mr. G. Schmalensee, collector of the Geological Survey of Sweden, I find a larger *Aerotretra* than the one described by Professor Linnarsson, which agrees with the description of *A. socialis* of Dr. v. Seebach and with his figures. Dr. Linnarsson writes that he thinks Professor v. Seebach had representatives of several species before him when he wrote his notes on *A. socialis*. With this I am in full agreement, but with the collections now before me from Bornholm and Öland, I think the specific name *A. socialis* should be given to the larger shell illustrated by Professor v. Seebach, and a new name to the smaller and very distinct shell illustrated by Dr. Linnarsson. In recognition of the faithful and intelligent work of Mr. Schmalensee I take pleasure in naming the species in his honor.

A. schmalensei is of the type of *A. subconica* Kutorga, but is much less elevated. It may be compared with *A. microscopica* and *A. gemma* among American species.

Formation and locality.—Middle Cambrian, *Paradoxides forchhammeri* zone, Island of Bornholm, Andrarum and Markarten and Lovened, Djupadalen, Vestergothana, Sweden; Borregaard, Bornholm, Denmark. *Paradoxides olandicus* zone, Windjuelandet, Ringsaker, Norway.

ACROTRETA SEEBACHI, new species.

Among the fragments of trilobites in the *Ceratopyge* limestone collected by Mr. Schmalensee there are a few specimens of a species of *Aerotretra* distinct from *A. schmalensei* and *A. socialis*. The pedicle valve is relatively low, with the false area nearly vertical. A cast of this valve shows the cardinal scars on each side high up toward the apex, small main vascular sinuses, and apical callosity. False area rather large and marked by a slight indication of a median depression that is recognized by a slight undulation in the transverse striae. Surface marked by fine thread-like concentric striae and lines of growth. A broken brachial valve has a broad median sulcus and a small, distinct beak at the posterior margin. The valves are slightly transverse. A large pedicle valve measures 3 mm. in width by 2.5 mm. in length.

The surface striae and the cardinal scars serve to distinguish this species from others known to me. *Aerothera ceratopygonum* Brögger is from the *Ceratopyge* shales, but it has a low pedicle valve, with the false area sloping forward.

Formation and locality.—*Ceratopyge* limestone, Slemmestad, etage

3 aj of Brögger, at Kristiania, Vestfonus, Eugervik, and doubtfully at Vakkerø near Kristiania, all in collection of University of Kristiania, collected by Dr. W. C. Brögger, Norway.

ACROTRETA SIGNALIS, new species.

Pedicle valve transverse, broadly ovate; height about one-third the length; apex directed backward on a line with the posterior margin, which is transverse and slightly undulated at the center by the median furrow of the slightly defined false area; apex with a minute apical foramen directed backward. Surface marked by fine concentric striae and lines of growth that at the median furrow of the false area curve toward the posterior margin. Shell small, 1.5 mm. long by about 1.75 mm. in width. Shell is built up of several very thin layers or lamellae.

In all of the great collections made from the Cambrian sandstones of the Upper Mississippi Valley, only two pedicle valves of any species of *Acrotreta* have been found, as far as known to me. These occur in association with *Obolus (Lingulepis) acuminatus*, and the shells have the color and appearance of those of that species. Shiny, light gray to white, the original coloring matter having been leached out. Only the exterior of the pedicle valve is known. This compared with *A. microscopica* shows a less elevated pedicle valve and less distinct false area. It also has a marked median groove on the false area. It recalls *A. idahoensis*, but differs in being more depressed and in having a stronger groove on a narrower false area.

Formation and locality.—Middle Cambrian, St. Croix sandstone, St. Croix Falls, Wisconsin.

ACROTRETA SOCIALIS v. Seebach.

Acrotreta socialis v. SEEBACH, Zeitsch. deutschen geol. Gesellsch., XVII. 1865, p. 341, pl. VIII, figs. 1-4.

The species described and illustrated by Professor v. Seebach as *Acrotreta socialis* is characterized by a well-marked concentrically striated surface and a strong median groove in the false area. In the collections made for me by Mr. Schmalensee at Oland, Borgholm, I find associated with *Paradoxides olandicus* an *Acrotreta* that has these characters. All the specimens from the *Paradoxides forchhammeri* zone belong to a distinct species which I have named *A. schmalensei*. Professor v. Seebach evidently had specimens of the latter species, also of a species of *Acrotreta* from the *Ceratopyge* limestone, as he mentions the occurrence of *A. socialis* at both horizons. As now restricted *A. socialis* occurs at Oland in the *Paradoxides olandicus* zone.

The external form, as far as known to me, is shown by the figures. There is some variation in the height of the pedicle valve and in the outline of the margins of the valves. The false area is clearly defined and marked by a strong, rather broad median groove. The foraminal

aperture is at the apex of the pedicle valve and quite readily seen in several specimens, a character in strong contrast with the minute aperture at the apex of *A. schmalensei*. Shell formed of several thin layers or lamellæ that show very plainly where the thin outer layer is exfoliated. Surface marked by striæ and lines of growth that are very distinct on some shells and less so on others; the concentric striæ occur on all the lamellæ of the shell and on the inner surface; fine radiating striæ are to be found on the inner surface. The cast of the interior of the pedicle valve shows the presence of a large apical callosity and unusually large foraminal tube and main vascular sinuses on each side of the visceral cavity. The cardinal scars are well defined in both the pedicle and brachial valves. Casts of the interior of the brachial valve show a strong median ridge, central scars, and fairly well-defined main vascular sinuses. Professor v. Seebach describes the surface as having minute warts on it. I find numerous fragments of the shell of *Acrotreta granulata* associated with *Acrotreta socialis*, and it may be that it was the surface of this shell that he mistook for that of the species he was describing. No known species of *Acrotreta* has such a surface.

A large pedicle valve has a diameter of 5 mm. and a height of 2.5 mm. The average size is about 3 mm. in diameter.

This species belongs to the *A. subconica* group of species, with a broad false area and well-defined median groove. Its surface is more strongly marked by concentric striæ than any other species of the genus, and the shell is also thicker.

Formation and locality.—Middle Cambrian. *Paradoxides olandicus* zone, Oland, Island of Borgholm, Sweden.

ACROTRETA SUBCONICA Kutorga.

Acrotreta subconica KUTORGA, Über die Siphonotretæ Verhandl., Russisch-Kaiserl., mineralogischen Gesell., 1848, p. 275, pl. vii, figs. 7a, b, c, b¹, c¹.

Original description.—Strongly conical; the deltidium-like furrow narrow and plainly impressed. Innumerable growth-wrinkles run on the whole surface of the shell horizontally, and make deflections only in the furrow, the convexity of which is turned toward the base of the cone.

Height of the cone, 0.014?; length of the base or of the ventral valve, 0.012?; breadth of the same, 0.015?.

Four specimens, of which one is complete and three are without ventral valve. From the collection of Herr v. Volborth.

On the specimen with the apex broken off I investigated the surface of the fracture, under the microscope with a magnification of 45 times, and found on it two cruriform, shallow impressions similar to those on the casts of the Siphonotretes. Their surface was polished and with impressions of growth folds; and between the extremities of the crura in the neighborhood of the area-like hinge surface, a columniform fragment of the mold of the siphon. From this it proceeds that the broken-off tip, just as the beak of the Siphonotretes, was solid and contained a cylindrical siphon.

Observations.—Through the courtesy and permission of Dr. F. Schmidt, Dr. F. Huene kindly sent me the types of this species, which he had been studying. One of them preserves the outer shell at the

apex. It shows a minute foraminal aperture on the back side of the apex and a strong median groove on the false area. The outlines of the pedicle valve vary from the somewhat diagrammatic drawings of Dr. Kutorga, and there is some variation among the five specimens representing the types.

Formation and locality.—Upper Cambrian, Popovke, near St. Petersburg, Russia.

LINNARSSONELLA, new genus.

Ventral (pedicle) valve convex with a slightly incurved beak projecting over a low false area. Foraminal opening just in front of the beak. A very slight trace of a pseudodeltidium occurs beneath the beak, dividing the area midway, as in the genus *Iphidea*; the false area arches slightly upward and backward in some specimens, while in others of the same species its edge is nearly coincident with the plane of the edge of the shell. The dorsal (brachial) valve is slightly convex, with a minute beak at the posterior margin. Surface marked by very fine concentric striae and undulations of growth. Shell strong, thick, and built up of a thin outer layer and numerous inner layers or lamellae that are arranged more or less obliquely to the outer layer. All the known species are small, not exceeding $2\frac{1}{2}$ mm. in diameter.

The cast of the interior of the pedicle valve shows the presence of two well-marked cardinal scars, one on each side of the main vascular canals, well toward the posterior border of the valves. The main vascular canals of the pedicle valve were large, extending nearly to the frontal margin, and including between them back of the center of the valve a small visceral area. The cast of the foraminal opening occurs just in front of the union of the main vascular sinuses. The cast of the interior of the brachial valve shows two large cardinal scars; two central scars, and traces of a minute antero-lateral scar; strong vascular canals; a well-defined false area and pseudodeltidium and a narrow median ridge extending in some shells to the anterior third of the valve.

Type, *Linnarssonella girtyi*. Second species, *L. minuta*. Third species, *L. broadheadi*. Fourth species, *L. tennesseensis*.

This is a most interesting type, combining characters of *Iphidea* and *Acrotreta*. *Bicia*, of the *Olenellus* fauna, has a strikingly similar dorsal valve, and the ventral is not unlike it if the narrow pedicle furrow of *Bicia* is closed, so as to provide a foraminal aperture.

L. girtyi occurs in great abundance in a single layer in the Middle Cambrian of the Black Hills, North Dakota, and also at two localities in Oklahoma Territory, northwest of Fort Sill. The valves of *L. minuta* almost cover a fragment of sandy shale from the Eureka District, Nevada. *L. broadheadi* is numerous in the Middle Cambrian limestones of Missouri. *L. tennesseensis* occurs quite abundantly in

sandy shales and thin-bedded sandstones, also in argillaceous shales above the Knox sandstone.

Failing to establish a satisfactory genus in honor of Dr. Linnarsson in the first instance, I make another attempt with this rare and interesting form.

LINNARSSONELLA GIRTYI, new species.

Shell minute. General form broad ovate to subcircular. Ventral (pedicle) valve convex; beak small and slightly incurved over the false area; false area short and varying from vertical to a backward inclination of 45° to 50° with the plane of the edge of the valve. In some examples the margin of the false area arches, while in others it appears to be straight. A very slightly indicated pseudodeltidium occurs beneath the beak, that gradually widens to the margin, very much as in *Iphidea pedlei*. Foraminal opening minute exteriorly, but the tube increases in size toward the inner surface of the shell. In one very perfect shell the aperture appears to open into a narrow elongate depression just in front of the beak, but it usually is seen as a minute circular perforation in front of the beak. Dorsal (brachial) valve gently convex, with a minute beak at the posterior margin. Surface of the shell glossy and smooth to the unaided eye, but a strong magnifier shows very fine concentric striae and lines of growth. The inner surface is marked outside of the visceral area by very fine radiating striae. The shell is formed of several layers or lamellae, and, judging from the depth of the impressions of the muscle scars and vascular markings, is rather thick over the central and posterior portions. The average length of the ventral valve is 1.5 to 1.75 mm. The dorsal valve is slightly shorter.

The cast of the interior of the pedicle valve shows the presence of a large cardinal sear on each side of the visceral area and outside of the very strong vascular canal; they are oval in outline and probably the point of attachment of strong muscle or muscles. The visceral area is small, but is well defined. Of the vascular canals, only the main trunks are shown by strong ridges in the casts; in one specimen they extend almost in a direct line from the beak to the antero-lateral margins of the valve. The cast of the interior of the foramen is usually broken off. The interior of the brachial valve is beautifully shown by one specimen; the narrow area with its well-defined pseudodeltidium, the large oval cardinal scars immediately in front of the area, and the strong vascular canals are as clearly defined as in the large shells of *Obolus*. The cardinal scars are divided into three parts by two transverse lines crossing the outer slope more or less obliquely, but the divisions on the two sides are unequal; the inner slopes of the scars are finely polished and afford no evidence of the attachment of muscles. Traces of the central scars occur on the outer slope of the cast of a

rather strong median ridge; they are elongate oval in outline, the major axis inclining posteriorly toward the median ridge. What may be the impression of an antero-lateral scar occurs on the median ridge a little in advance of the central scars.

Observations.—I collected a large number of this little shell in a layer of gray limestone about 100 feet above the quartzitic sandstone at the base of the Cambrian in the Black Hills. The associated trilobites and brachiopods belong to the Middle Cambrian fauna of the Upper Mississippi Valley and eastern Rocky Mountain region. This species differs from *L. minuta* in the greater convexity of the pedicle valve and the median ridge of the dorsal valve. The specific name is given in recognition of the paleontologic work of Dr. George H. Girty.

Mr. E. O. Ulrich found this species in 1901 in great abundance in gray limestones interbedded in the lower portion of the Middle Cambrian section of the Wichita Mountains, and Mr. R. Greger collected it in the Middle Cambrian limestones near Potosi, Missouri.

Formation and locality.—Middle Cambrian limestone in north suburb of Deadwood, Black Hills, South Dakota. Also at the same relative horizon in Oklahoma Territory in calcareous layers of the Regan greensand; one locality is 15 miles northwest of Fort Sill, one-half mile east of Canyon Creek, Wichita Mountains, and another is about 4 miles east of Canyon Creek in the southwest quarter section 17, T. 4 N., R. 12 W.

LINNARSSONELLA MINUTA Hall and Whitfield (sp.).

Lingulepis (?) *minuta* HALL and WHITFIELD, Geol. Expl. Fortieth Parallel, IV, 1877, p. 206, pl. 1, figs. 3 and 4.

Lingulepis (?) *minuta* WALCOTT, Mong. U. S. Geol. Sur., VIII, 1884, p. 13

Lingulella minuta SCHUCHERT, Bull. U. S. Geol. Sur., No. 87, 1897, p. 257.

Shell small; general form broad ovate, with the pedicle valve slightly subacuminate. The convexity of the two valves is nearly the same and in each the minute beak is at the posterior margin. The false area of the pedicle valve is small and divided midway by a faint, narrow, pseudodeltidium; it is on the plane of the margin of the valve. Foraminal opening minute, elongate, and situated on the slope just in front of the beak. Brachial valve a trifle less convex than the pedicle.

The outer surface of the shell is marked by fine concentric striae and lines of growth and the inner lamellæ and inner surface by fine radiating striae. The shell is formed of several thin layers or lamellæ, those of the anterior and lateral portions being more or less oblique to the outer surface layer; the shell is also thickened in the visceral region by irregular additions on the inside. The average length of the pedicle valve is 2 to 2.5 millimeters; the dorsal is a little shorter.

The interior of the pedicle valve shows a cardinal scar on each side, well out toward the lateral margin, which corresponds to the position of the transmedian and antero-lateral scars in *Obolus apollinis*. The visceral area is small and compressed between the sinuses occupied by the large, main vascular canals. The opening of the foraminal tube is oval and situated at the posterior portion of the visceral depression at the margin of the area. The main vascular canals start near the beak and gradually diverge toward the antero-lateral margins of the valve. The interiors of the brachial valve associated with the two pedicle valves illustrated are all so imperfect that only a median ridge like that in *Acrotreta* can be clearly determined. This ridge varies greatly in size and length in different specimens.

Observations.—In a hasty examination of this species in 1884, I confused the dorsal valve with that of *Acrotreta* and considered the ventral valve as the type, placing it under *Lingulepis*, stating that it had “nearly the same vertical range and geographic distribution as *L. maera*.” As now known, it is confined to the one locality discovered by the geologists of the Fortieth Parallel Survey, and to a single slab of reddish-brown sandy shale on which a large number of the separated valves occur.

The generic reference is somewhat doubtful on account of the difference in what is known of the interior of the dorsal valve and the position of the area of the ventral valve.

Formation and locality.—Upper Cambrian, Hamburg Ridge, Eureka district, Nevada.

LINNARSSONELLA TENNESSEENSIS, new species.

General form of pedicle valve rounded subtriangular, moderately convex, with the beak curving gently over a very low false area nearly to the posterior margin. Foraminal opening minute and situated a little in front of the beak. Brachial valve moderately convex, with the beak marginal.

Surface of shell marked by fine concentric striae and lines of growth. The interior surface shows a few fine radiating striae. Shell rather thick and built up of several thin layers or lamellae.

The cast of the interior of the pedicle valve shows small cardinal scars and a minute foraminal tube directed backward very much as in *Obolus atlantica*. The main vascular canals of the pedicle valve are outlined nearly to the antero-lateral margins and include between them a narrow visceral area. The cast of the brachial valve indicates relatively strong cardinal scars, distinct central scars, and a narrow median ridge. None of the specimens show the main vascular canals except at their base.

Observations.—This shell has the general outline of *L. girtyi*, but it differs in having the pedicle valve more acuminate, less convex, and

in the apex curving over nearly to the posterior margin. It has the outline of *L. minuta*, but not the strong vascular sinuses and small cardinal scars of the pedicle valve of that species. From *L. broadheadi* it varies in outline and convexity.

Formation and locality.—Middle Cambrian, in shales and sandstones above the Knox sandstones, Bull Run, Copper Ridge, 11 miles west of Knoxville; 6 miles northeast of Knoxville; 1½ miles east of Post Oak Springs, Roane County, all in Tennessee.

OBOLUS (LINGULELLA) SCHMALENSEI, new species.

This is the European representative of the American *Obolus* (*L. rotundatus*). Its outline is slightly elongate to subcircular. When the shell is exfoliated the cast indicates that it was strong over the visceral area and thin toward the margins.

The specific name is given in honor of M. Schmalensee, who collected the material for me.

Formation and locality.—Middle Cambrian limestones of *Paradoxides forchhammeri* zone, Skane, Andrarum, Sweden.

BRÖGGERIA, new subgenus.

Type, *Obolus* (*Bröggeria*) *salteri*.

This subgenus differs from the typical forms of *Obolus* in having a very deep visceral depression in both valves and a minutely papillose interior surface. A series of shells showing the effect of compression on the appearance of the interior casts of the valves will be illustrated in the monograph.

OBOLUS (BRÖGGERIA) SALTERI Holl.

Obolella salteri HOLL, Quar. Jour. Geol. Soc., XXI, 1865, p. 101, fig. 9.

? *Obolella salteri* DAVIDSON, Brit. Foss. Brach., III, 1870; Sil. Brach., p. 61, pl. iv, figs. 28, 29.

Obolus salteri BRÖGGER, Die Silurischen Etagen 2 und 3, 1882, p. 44, pl. x, figs. 10, 11, 13.

Obolus ? *salteri* MICKWITZ, Mem. Imp. Acad. Sciences, St. Petersburg, VIII, 1896, 4 ser., No. 2, p. 19.

Original description.—Compressed, subtriangular to nearly round, rather broader than long; shell thin; surface grooved concentrically by a few inequidistant, strongly marked lines of growth, and by numerous finer lines which are distinct only on the sides of the shell. Length usually about one-third inch; width slightly more.

Position.—In the Black Shales. [The Black Shales are referred to Upper Cambrian, the locality being in the eastern portion of the Malvern Hills of England.]

Mr. Davidson copies Holl's description and figure. Dr. W. C. Brögger, however, identifies the species from the Upper Cambrian *Ceratopyge* slate and limestone of Sweden, illustrating a form from the slate, and a very beautiful interior of what appears to be a dorsal valve of this species from the limestone.

Through the courtesy of Dr. Brögger, I studied the material representing this species collected in Norway.

In a collection kindly sent me by Dr. G. Lindström I find two ventral valves from the black shale of Skane, but it is in the collection made by Mr. v. Schmalensee that specimens occur showing the casts of the interior of the dorsal valve. These have the imprint of the central visceral area; the large vascular sinuses, and the area. A cast of an uncompressed shell proves that the visceral area was short and relatively small. Comparing the matter, I am led to conclude that the latter is a partially exfoliated specimen preserving the vascular markings on the thin inner layers of the shell.

In Cape Breton this species occurs abundantly in association with *Obolus (Lingulella) concinnus* Matthew, and *Aerotreta bisecta* Matthew. The shells are all compressed in the shale, but a direct comparison of the interiors of the valves of specimens from Cape Breton and from the *Ceratopyge* shales of Sweden shows the two to be identical in all characters except the length of the area and pedicle groove. The Cape Breton shells have a longer area, but whether this is owing to the conditions of preservation or not, I am unable to decide, as the material from Sweden is very imperfect about the area. On one of the Cape Breton shells the fine punctæ of the interior surface are clearly shown.

Formation and localities.—Upper Cambrian. Black shale 3 f, *Dictyograptus* series; greenish arenaceous *Ceratopyge* shale 4a, Bornholm. In dark, ferruginous sandstone, associated with fragments of *Olenus tornquisti* Moberg, Skane Fagelsang, Sweden. Étage 3 aj. Vestfossum; Engervik, Asker; Slemmestad Roken, 3 ab, Kristiania, Norway. Argillaceous shale, Barachois 11n, 4 miles south of Little Bras D'or Lake, Cape Breton, Nova Scotia.

OBOLUS (LINGULELLA) LENS Matthew.

Lingula? lens MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, IV, 1900, p. 274, pl. v, figs. 3a, 3b.

Obolus (Lingulella) bellus WALCOTT, Proc. U. S. Nat. Mus., XXIII, 1901, p. 685.

General form broadly ovate. The ventral valve is subacuminate and the dorsal valve very broadly ovate to subsemicircular. The convexity of the valves is moderate, the ventral valve being most prominent along the center, with the postero-lateral slopes somewhat flattened toward the margin.

Surface of the shell marked by fine, concentric striae and lines of growth, and the inner surface by concentric lines and very fine radiating striae. The shell is thinner than most species of the subgenus, resembling in this respect *Lingula murrayi* and *O. (L.) bellus*. It is formed of several layers or lamellae that are slightly oblique to the outer layer. Dr. Matthew speaks of minute pits on the outer surface. These also appear on the inner layers. I have been unable to deter-

mine whether the thin calcareous crust mentioned by Dr. Matthew is really the true outer layer or simply a thin calcareous deposit.

The largest specimen of a dorsal valve in the collection has a length of 15 mm., with a width of 13 mm. The corresponding ventral valve was probably 1 or 2 mm. longer.

Observations.—In the material collected by Mr. S. Ward Loper in 1901 there are some specimens that show the form of the ventral and dorsal valves of this species. The shell is broader and rounder than I supposed when studying the material Dr. G. F. Matthew sent me. It is quite distinct from *O. (L.) bellus* and *O. (L.) concinnus*, with which I placed it. The interior markings are those of *Lingulella*, but it may be that more perfect material would prove it to belong to some other subgenus of *Obolus*.

Formation and locality.—Upper Cambrian, thin calcareous layers in the arenaceous shales at McAdams shore, Escasonie, Cape Breton, Nova Scotia.

OBOLUS (LINGULELLA) SPATULUS, new species.

General form of the ventral valve spatulate, the sides sloping from the apex forward with a very slight curvature to the anterior fifth of the shell, where they pass into the broadly rounded frontal margin.

Dorsal valve ovate, with the greatest width toward the front. Convexity moderate, and about equal in both valves. A ventral valve 9 mm. in length has a convexity of about 1 mm. A fragment of the outer surface indicates that the surface was relatively smooth, being broken only by fine, scattered striae of growth. The inner layers show concentric lines, also fine, radiating striae. The interior of the shell was marked by scattered postules, concentric striae, and a few radiating lines.

The largest ventral valve has a length of 9 mm. and a width of 6 mm. A dorsal valve 5 mm. in width has a length of 7 mm.

The only traces of the vascular system preserved is the median ridge of the dorsal valve, which extends forward to the anterior fourth of the shell.

Observations.—This very pretty little shell occurs in abundance in the chocolate-brown sandstone interbedded in the shales just above the massive Tonto sandstone. It is distinct from all other species known to me from the Cambrian rocks of the Grand Canyon region. *O. (L.) chuarvensis* occurs in a layer of sandstone 50 or 60 feet higher up in the section.

Formation and locality.—Middle Cambrian, Tonto sandstone series, just above massive sandstone near mouth of Bass Canyon, on the south side of the Grand Canyon of the Colorado, southeast of Powells Plateau, Arizona.

OBOLUS (LINGULELLA) WELLERI, new species.

General form elongate ovate, with the ventral valve subacuminate and the dorsal valve subelliptical. Owing to the more or less crushed condition of all the specimens the exact convexity of the entire valve is unknown. Surface of the shell marked by numerous elevated concentric lines of growth and very fine, slightly irregular, interstitial concentric striae.

When the outer surface is exfoliated the inner layers show fine radiating striae and concentric lines of growth. Nothing is known of the interior surface of the shell. The shell appears to have been relatively thin and formed of several layers or lamellae.

A ventral valve 14 mm. in length has a width of 9 mm., and a dorsal valve 10 mm. in length has a width of $7\frac{1}{2}$ mm. In both valves the width is slightly increased by the flattening of the shell.

Observations.—This species occurs in association with *O. (Lingulepis) acuminatus* in an arenaceous magnesian limestone. It differs from described species in the elliptical form of the dorsal valve and the strongly filose concentric striae of the outer surface. The specific name is given in honor of Prof. Stuart Weller, who discovered the locality. The specimens representing the species were collected by Mr. Henry Dickhaut.

Formation and locality.—Upper Cambrian, magnesian limestones, O'Donnell & McManiman's quarry, Newton, New Jersey.

OBOLUS (LINGULELLA) CONCINNUS Matthew.

Lingulella concinna MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, IV, 1900, p. 273, pl. v, figs. 2a-b.

Obolus (Lingulella) bellus WALCOTT, Proc. U. S. Nat. Mus., XXIII, 1901, p. 685.

General form ovate, with the ventral valve subacuminate and the dorsal valve broadly ovate. There is considerable variation in the outlines of the valves. The convexity of the valves is fairly strong, although they are usually more or less flattened and compressed in the arenaceous shale.

Surface of the shell is marked by fine concentric striae and lines and ridges of growth. When the outer surface is exfoliated numerous fine radiating striae occur in the inner layers or lamellae. The inner surface is marked by concentric lines of growth. In some specimens scattered minute pits occur that are sometimes arranged in the cast like beads along the lines of growth. The shell is of moderate thickness and formed of a thin outer layer and several inner layers or lamellae that are slightly oblique to the outer layer. In the older shells the oblique lamellae form laminated ridges of growth. Some of the larger ventral valves have a length of 10 to 12 mm., but the average length is about 8 mm.

The area of the ventral valve is about one-fifth the length of the shell. It is divided midway by a narrow, strongly marked pedicle furrow, and midway between the pedicle and lateral margins by a sharp flexure line. The striae of growth cross parallel to its base. The area of the dorsal valve is relatively short, but extends well out onto the cardinal margins. Although there is a large series of specimens, and many of them with the surface of the shell exfoliated, nothing is known of the vascular markings or muscle scars.

Observations.—When studying *O. (L.) bellus* in 1900, I came to the conclusion that *O. (L.) concinnus* and *O. (L.) lens* from Cape Breton were identical, but with still larger collections obtained by Mr. S. Ward Loper in 1901 from Cape Breton, especially of *O. (L.) lens*, it appears that the outlines of *O. (L.) bellus* are more uniformly subquadrate in the adult specimen of the dorsal valve than the Cape Breton form. *O. (L.) concinnus* and *O. (L.) bellus*, however, are closely related and both occur in the Upper Cambrian beds.

Formation and locality.—Upper Cambrian. Arenaceous shale at several localities on McNeils Brook; also, ravine one-half mile north of McMullin's, on crossroad to Boisdale railroad station; in ravine east of railroad, just south of Barachois post-office; Upper Leitches Creek, Cape Breton, Nova Scotia.

OBOLUS (LINGULELLA) ATAVUS Matthew.

Leptobolus atavus MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, IV, 1899, p. 200, pl. II, figs. 1 a-f.

Obolus (Lingulepis) gregeva WALCOTT, Proc. U. S. Nat. Mus., XXIII, 1901, p. 692.

General form elliptical, with the ventral valve subacuminate and the dorsal valve broadly subacuminate in outline. In the shorter form of the valves the sides are almost uniformly rounded from the cardinal slopes to the frontal margin. The convexity of the valves is fairly strong, that of the dorsal valve being broken by a slight longitudinal flattening that extends from the posterior portion to the frontal margin. As shown by the matrix, the outer surface is marked by concentric ridges and fine striae of growth. The interior cast shows concentric lines and traces of rather coarse radiating lines. None of the specimens preserve the shell, but from the strength of the interior surface markings it is inferred that the shell was rather thick.

The longest ventral valve in the collection has a length of 6 mm., width $3\frac{1}{2}$ mm. The dorsal valves are slightly shorter.

The area of the ventral valve is divided at the center by a strong pedicle furrow, and about midway between the pedicle furrow and the outer margin by clearly marked flexure lines that extend from the apex with a slightly outward curvature to the base of the area. Striae of growth cross the area parallel with its base, being much stronger on the area than in the pedicle furrow. The area of the dorsal valve

is fully as prominent as that of the ventral valve. It curves forward at the center and extends well out on the cardinal slopes. The flexure lines are clearly defined well out toward the lateral margin. The striae of growth cross the area parallel to the base.

The cast of the interior of the ventral valve shows only the outline of the visceral cavity and that the main vascular sinuses extend a considerable distance in advance of the visceral cavity. The cast of the interior of the dorsal valve shows that it had a strong, broad, central ridge divided by a faint longitudinal median sinus. Only traces have been seen of the main vascular sinuses.

Observations.—This is a very pretty little species that I confused with the young of *Obolus* (*Lingulepis*) *gregwa* in the absence of well-defined specimens. Material collected by Mr. S. Ward Loper at the type locality proves that the shell differs considerably from the young of *O. (L.) gregwa*. It also differs, in being regularly oval, from *O. (L.) collicia* Matthew, with which it is associated, and *O. (L.) canius* Walcott, from the *Paradoxides* horizon of Cape Breton.

Formation and locality.—Middle Cambrian, Matthew's Etcheminian, just above the conglomerate at the base of the section on Dougal Brook, branch of Indian River, Cape Breton, Nova Scotia.

OBOLUS (LINGULELLA) COLLICIA Matthew.

Leptobolus? collicia MATTHEW, Bull. Nat. Hist. Soc. New Brunswick, IV, 1899, p. 200, pl. 1, figs. 3 a-c.

This shell is associated with *O. (L.) atavus*. It differs from it in being larger and in having a more acuminate and broader ventral valve and a more broadly oval dorsal valve. The exterior surface is marked by very fine, slightly irregular, concentric striae.

Formation and locality.—Middle Cambrian, Matthew's Etcheminian, just above the conglomerate at the base of the section on Dougal Brook, branch of Indian River, Cape Breton, Nova Scotia.

OBOLUS (LINGULELLA) CANIUS, new species.

Shell small; general form elongate oval, with the ventral valve slightly acuminate. In both the ventral and dorsal valve the shell narrows posteriorly, the front being broadly rounded. The convexity of the two valves is well marked, and it is nearly the same in each.

Surface of the shell marked by fine concentric striae and a few lines of growth. When the outer shell is exfoliated fine radiating striae cross the fine concentric striae. The shell appears to be of moderate thickness and formed of several thin layers or lamellae. The largest ventral valve in the collection has a length of 5 mm. and a width of 3 mm., and a dorsal valve 4 mm. in length has a width of 2 mm.

The area of the ventral valve is elongate, being nearly one-fifth the length of the shell. It is divided midway by a very distinctly

defined pedicle furrow. The flexure line is just perceptible about half the distance out from the pedicle furrow to the lateral margin. The area extends well forward on the cardinal slopes, and is marked by strong striae of growth parallel to its base. The area of the dorsal valve is shorter than that of the ventral. It is marked by fine lines of growth and clearly marked flexure lines that extend from the apex forward on a line with the main vascular sinuses.

The cast of the interior of the ventral valves shows a general outline of the visceral cavity and the main vascular sinuses. Only the base of the main vascular sinus has been seen in the dorsal valve.

Observations.—This very pretty little species occurs in association with *Paradosides*. In my first study of the brachiopods collected by S. Ward Loper from Cape Breton I confused it with the young of *O. (L.) gregwa*. By means of a larger collection made by him in 1901 I have been able to separate it from the young of the associated *O. (Lingulepis) paradosides*, and from the somewhat similar species that occur at a lower horizon, *O. (L.) atavus* and *O. (L.) collicia*. It differs from both the latter species in having a more elongate oval outline.

Formation and locality.—Middle Cambrian; compact, fine-grained, thin-bedded, grayish sandstone, McLean's Brook, 1½ miles west of Marian Bridge, Cape Breton, Nova Scotia.

OBOLUS (WESTONIA) FINLANDENSIS, new species.

General form elongate ovate, with the ventral valve subacuminate and the dorsal valve ovate in outline. Convexity of the two valves moderate. A ventral valve 11 mm. in length has a convexity of about 1.25 mm., and a dorsal valve 8 mm. in length a convexity of 1 mm. above the plane of the margin.

The outer surface of the shell is marked by concentric lines of growth, with very fine interstitial striae. The latter are crossed by fine radiating striae that are interrupted more or less by the concentric lines of growth. In addition to the concentric radiating striae there is a series of imbricating lines that are slightly oblique to the longitudinal axis of the shell. These lines terminate at right angles to the margins, curving inward and backward apparently to the opposite side. This type of ornamentation is much like that of several species of *Westonia*, except that it is somewhat more complicated.

The cast of the interior of the shell shows the interior surface to have been marked by scattered punctæ that had a tendency to gather concentrically on the lines of growth. A few rather strong radiating striae also occur outside of the visceral area.

The shell is rather thick. It is formed of a thin outer layer and several inner layers or lamellæ that are more or less oblique to the outer surface and marked near the front margin by fine radiating striae. The largest specimen has a length of 11 mm. with a width of 7 mm. The dorsal valve of the same width has a length of 8 mm.

The area of the ventral valve is unknown. That of the dorsal valve is strongly defined and extends well forward on the cardinal slopes. It is marked by transverse striae of growth parallel to the base.

The only interior markings known are in the dorsal valve. These indicate the course of the main vascular sinus and the size and length of the median ridge; also the position of the central muscle scars.

Observations.—The oblique imbricating lines on the outer surface of this species relate it closely to *O. (Westonia) stoneanus* and *O. (W.) escasoni*. The two specimens showing the outer shells are unfortunately slightly worn along the median line, so that it is not possible to trace the growth of the oblique imbricating lines entirely across the shell. In form the shell resembles *O. (L.) acutangulus*. It occurs in the compact, fine-grained, quartzitic sandstone, in association with *Ellipsocephalus (Liostracus) muticus* Angelin, in the *Paradoxides tessini* series. The material was collected by M. v. Schmalensee.

Formation and locality.—Middle Cambrian, Aland Saltvik, Finland.

ON CERTAIN SPECIES OF FISHES CONFUSED WITH BRYOSTEMMA POLYACTOCEPHALUM.

By DAVID STARR JORDAN and JOHN OTTERBEIN SNYDER
Of the Leland Stanford Junior University.

Some confusion has arisen in the works of recent authors concerning the identity of a species of Blenny, described by Pallas¹ as *Blennius polyactcephalus*. Dr. Tarleton H. Bean² figured a blenny from Alaska which he believed to be identical with the species named by Pallas. Herzenstein³ described *Chirolophus japonicus*, a supposed new species from Hakodate, Japan, which Jordan and Evermann regard as synonymous with the *Blennius polyactcephalus* of Pallas. Again, Jordan and Starks⁴ described a specimen from near Seattle as *Bryostemma polyactcephalum*, applying for the first time the generic name *Bryostemma*, the type of which is the species described. Other fishes supposed to belong to the same form are also recorded. Later, Jordan and Gilbert⁵ identified a specimen from Petropaulski, stating that it agreed perfectly with the description given by Pallas. Jordan and Evermann⁶ examined the specimens here mentioned, except the ones possessed by Bean and by Herzenstein, referring all to the species *Bryostemma polyactcephalum*, not, however, without considerable doubt, remarking that they "show a great deal of variation and possibly represent three different species."

A reexamination of the same material shows that four entirely distinct species were represented in the collection, as will appear. The example from Petropaulski, identified by Jordan and Gilbert, belongs

¹ Pallas, Zoographia Rosso-Asiatica, III, 1811, p. 179.

² Bean in Nelson, Report upon Natural History Collections made in Alaska, 1887, p. 305, pl. xv, fig. 2.

³ Herzenstein, Mélanges Biologiques tirés du Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg, XIII, 1890, p. 123.

⁴ Jordan and Starks, The Fishes of Puget Sound, Proceedings of the California Academy of Sciences, 1895, p. 841.

⁵ Jordan and Gilbert, Fishes of Bering Sea, in Report of the Fur-Seal Investigations, Pt. 3, p. 479.

⁶ Jordan and Evermann, Fishes of North and Middle America, III, p. 2408.

without doubt to the species described by Pallas. It agrees in every detail with the account given by that author and also equally well, as Jordan and Gilbert say, with *Chirolophus japonicus* of Herzenstein. The specimen figured by Bean differs from the one described by Pallas, as is shown in the following pages. That described by Jordan and Starks and indicated as the type of the genus *Bryostemma* is identical with the form figured by Bean. It becomes the type of a new species, *Bryostemma decoratum*. Of the specimens collected by the U. S. Fish Commission steamer *Albatross* in Alaska, and recorded by Jordan and Starks and later by Jordan and Evermann, the one having "the cheeks covered with densely matted cirri" proves to be a new species, *Bryostemma tarsodes*. The others cited as young examples belong to a different genus, now recognized for the first time as *Bryolophus*. The species being new, may be known as *Bryolophus lysimeus*.

Descriptions of the new forms are here given.

BRYOSTEMMA TARSOIDES Jordan and Snyder, new species.

Bryostemma polyuctocephalum JORDAN and STARKS, Proc. Cal. Acad. Sci., 1895, p. 841 (in part).—JORDAN and EVERMANN, Fish. North and Middle America, III, p. 2408 (in part).

Head $6\frac{2}{3}$ in length; depth $6\frac{1}{2}$; depth of caudal peduncle 3 in head; eye $3\frac{1}{2}$; interorbital space 7; snout 5; dorsal LX; anal I. 45.

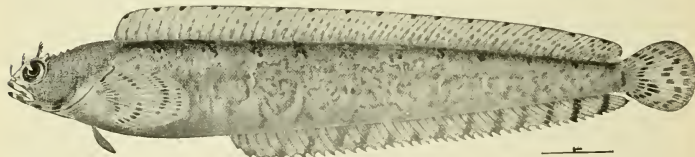


FIG. 1.—BRYOSTEMMA TARSOIDES.

Interorbital space broad, convex; snout short, jaws equal; maxillary extending to a vertical through posterior border of orbit. Teeth rather strong, acutely conical, placed alternately in 2 closely apposed rows, the points nearly aligned in a single cutting edge; no teeth on vomer and palatines. Gill-membranes forming a broad fold across the isthmus. Pseudobranchiæ large; gill-rakers on first arch about 15, short, broad, pointed, close together.

Body covered with minute scales, the head naked; membranes of fins without scales. Lateral line represented by a short row of 5 pores above the gill-openings, the pores concealed by papillæ. Cheeks, snout, and whole upper part of head closely covered with tentacles and papillæ. Snout with a median branched tentacle; upper border of orbit with three large, branched tentacles, the first not united with its fellow of the opposite side, the second highest, its length equal to vertical diameter of the eye, third short and club-shaped; on the

interorbital space between the anterior pair of orbital tentacles is a minute, blunt, papilla; posterior to this and between the second pair is a somewhat larger one; behind the latter and between the third pair of orbital tentacles is a pair of short, stocky tentacles; behind these are two transverse rows of similar protuberances, five in the first and three in the second row; the whole occiput and nape, the sides of the head, the cheeks, and suborbital area covered with pointed, fleshy villi; a small barbel on posterior end of maxillary; a pair of branched tentacles on chin followed by a similar one on posterior half of jaw; a prominent barbel on suborbital area. Nostrils with slender, pointed tubes.

Dorsal inserted above the gill-opening, the membrane not scalloped between the spines, scarcely connected with the caudal posteriorly; two or three anterior spines probably with small terminal tentacles (the fin being slightly injured, the character of the first spines can not be exactly determined, but if tentacles are present they do not extend beyond the third spine); height of spines near middle of fin $2\frac{1}{2}$ in head. Anal inserted below base of fourteenth dorsal spine, the membrane incised between the rays, not joined to the caudal, height of rays near middle of fin, 3 in head. Caudal rounded, $1\frac{1}{2}$ in head. Pectoral $1\frac{1}{2}$ in head. Ventrals 3 in head.

Color in spirits, light yellowish brown, with irregular whitish spots along the sides; a row of 10 indistinct, brownish bars along back between nape and tail; side of head with 2 or 3 indistinct vertical bars; edge of dorsal with small, widely spaced, brown spots; anal with about 13 large spots; caudal and pectoral with irregular, vertical bars.

Known from only one specimen 115 mm. long, taken by the U. S. Fish Commission steamer *Albatross* at Station 3213, near Unalaska, Alaska. Type 50570, U. S. National Museum.

The species may be distinguished at once among others of the genus by having the sides of the head covered with a dense mat of barbels. (*ταρσώδης*, matted.)

BRYOSTEMMA DECORATUM Jordan and Snyder, new species.

Chirolophus polyactcephalus BEAN in Nelson, Report Nat. Hist. Coll. Alaska, 1887, p. 305, pl. xv, fig. 2.

Bryostemma polyactcephalum JORDAN and STARKS, Proc. Cal. Acad. Sci., 1895, p. 841 (in part).—JORDAN and EVERMANN, Fish. North and Middle Amer., III, p. 2408 (in part), fig. 828; the specimen from Neah Bay represents this species.

Head $6\frac{3}{4}$ in length; depth $6\frac{1}{3}$; depth of caudal peduncle $3\frac{1}{2}$ in head; eye $4\frac{1}{2}$; interorbital space 9; snout $4\frac{1}{2}$; dorsal LXII; anal I, 44.

Body elongate, greatly compressed; head small, the snout blunt. Jaws about equal, the lower projecting slightly. Maxillary extending to vertical through center of pupil. Teeth of jaws placed alternately in two very closely apposed series, the points aligned to form a single

cutting edge; no teeth on vomer or palatines. Gill-membranes forming a broad, somewhat V-shaped fold across the isthmus. Pseudo-branchiæ large; gillrakers small, slender, about 15 on the first arch.

Body covered with minute, cycloid scales; membranes of fins without scales; head naked. Lateral line represented by a short row of 9 or 10 pores, extending backward from above gill opening, each pore below a minute villus. Nostrils with slender pointed tubes. Head and nape with many tentacles; a large pair on anterior part of interorbital space, joined at their bases, fringed at tip and along the sides, their height about two times the diameter of eye; posterior border of interorbital space with three short tentacles, the outer one rather broad and branched, the inner one slender and pointed; occiput and nape as far back as base of third dorsal spine with many pointed tentacles, none of which is branched; symphysis of lower jaw with a pair of minute villi; none along sides of jaws; a few small villi along edges of opercle and preopercle.



FIG. 2.—*BRYOSTEMMA DECORATUM*.

Dorsal fin inserted immediately above upper edge of gill-opening, the membrane broadly scalloped between the first five spines, not incised between the other spines, joined to base of caudal rays; first spine with small villi on its anterior edge; first eight or nine spines with branched tentacles extending upward from their tips, the anterior tentacle highest, the others growing gradually shorter to the last, which scarcely projects above the fin; spines near middle of fin contained about two and one-third times in the head. Anal inserted below base of seventeenth dorsal spine, the spine weak and small, the membrane deeply incised between the rays, not joined to caudal; length of rays near middle of fin 3 in head. Caudal rounded, the rays below middle of fin slightly longer than those above, the longest contained one and three-fifths times in the head. Pectoral rounded, its length about equal to that of the head. Ventrals narrow, the length contained about two and three-fifths times in the head.

Color plain; about twelve very indistinct small brownish spots on the dorsal; the anterior is the most prominent; six or seven faint dark spots on posterior half of anal; cirri on upper part of head faintly marked with brown.

Described from a specimen 160 mm. long, collected by Prof. O. B. Johnson at Point Orchard, near Seattle, Washington.

Type.—No. 3156, Ichthyological collections, Stanford University.

The type resembles closely the specimen figured by Bean, except that the dorsal is not inserted quite so far forward as there represented, the pectoral is shorter, and the body and fins are not spotted with white. The type is evidently a faded example which was more brightly colored in life.

This species closely resembles *Bryostemma polyactoecephalum*, the character of the filaments, however, serving to distinguish them. In the latter species the posterior interorbital pair are higher than the anterior ones, many of the occipital ones are branched, there are a number on the sides of the jaws, and those on the dorsal fin are fewer, smaller, and less ornate. The species in hand is a much more slender and less stoutly built form.

(*decoratum*, ornamented.)

BRYOLOPHUS Jordan and Snyder, new genus.

The genus for which the above name is proposed is represented by *Bryolophus lysimus*, a new species. It is apparently closely related to *Bryostemma*, from which it is distinguished by having the teeth in bands instead of in two closely apposed series with the tips aligned to form a single cutting edge.

Body elongate, compressed; mouth small; gill-membranes forming a fold across the isthmus; teeth in narrow bands on the jaws; no teeth on the vomer and palatines; body with minute scales, the head naked; lateral line represented by a short series of pores above the pectoral; interorbital space and occiput with cirri; dorsal inserted above gill-opening, of spines throughout; ventrals jugular; caudal distinct.

(*βρύον*, moss; *λόφος*, crest.)

BRYOLOPHUS LYSIMUS Jordan and Snyder, new species.

Bryostemma polyactoecephalum JORDAN and STARKS, Proc. Cal. Acad. Sci., 1895, p. 841 (in part).—JORDAN and EVERMANN, Fish. North and Middle America, III, p. 2408 (in part).

Head 6 in length; depth $6\frac{1}{2}$; depth of caudal peduncle $4\frac{1}{5}$ in head; eye 4; interorbital space 10; snout $4\frac{1}{2}$; dorsal LXI; anal I, 48.

Snout short, blunt; mouth rather small, the maxillary extending to anterior edge of orbit, the lower jaw projecting slightly. Teeth small, acutely conical, in narrow bands on the jaws, none on vomer and palatines. Gill-openings forming a somewhat V-shaped fold across the isthmus. Pseudobranchiæ large; gillrakers on first arch 18, rather long and pointed.

Body with minute scales; membranes of fins naked, or with a few scales on basal parts; head naked. Lateral line represented by a series

of 7 or 8 pores above the gill-opening. Upper part of head with cirri and tentacles; a long, slender, median tentacle on snout, two pairs of branched ones on the interorbital space, the anterior ones united at their bases, the posterior pair widely separated, as high as, or higher than the others; occiput and nape with very slender, long cirri; sides of head naked; chin with a pair of small barbels.

Dorsal inserted above gill-opening, not united to base of caudal, the first three or four spines with small, terminal tentacles; height of spines near middle of fin $2\frac{1}{2}$ in head. Anal inserted below base of seventeenth dorsal spine, not connected with base of caudal, the membrane incised between tips of rays; height of rays near middle of fin 3 in head. Caudal acutely rounded, $1\frac{1}{3}$ in head. Pectoral $1\frac{1}{2}$ in head. Ventrals 3 in head.

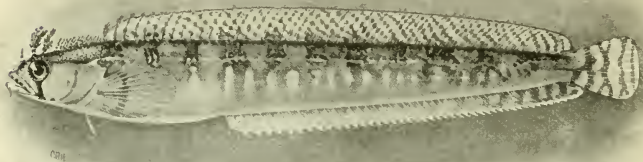


FIG. 3.—*BRYOLOPHUS LYSIMUS*.

Color in spirits, yellowish white; the body with about 14 indistinct vertical brownish bands, the upper parts of which are darker, appearing as a series of blotches below base of dorsal; a faint, brownish band extending downward from eye; tentacles and cirri brownish; dorsal finely mottled with brownish, a rather distinct spot above tip of pectoral; caudal with narrow, irregular wavy bands; anal with a few faint spots on posterior part.

Described from the type, No. 50571, U. S. National Museum, a specimen about 100 mm. long collected by the U. S. Fish Commission steamer *Albatross* at Station 3213, near Unalaska. Two other specimens are very similar in color. They have 62 and 63 dorsal spines and 48 and 49 anal rays, respectively. These examples bear the cotype No. 3049, Ichthyological collections, Stanford University.

(*λύσιμος*, restorable.)

THE SHOULDER GIRDLE AND CHARACTERISTIC OSTEOLOGY OF THE HEMIBRANCHIATE FISHES.

By EDWIN CHAPIN STARKS,

Of the Leland Stanford Junior University.

My investigations of the group of Hemibranchiate fishes were undertaken primarily with a view of ascertaining the character of the interclavicles and making a comparative study of the shoulder girdle. So many important characters appeared, however, in other parts of the skeleton, and so many errors were found in current descriptions, that the scope of the paper has been somewhat broadened.

I have tried to describe in detail the posterior bones of the cranium in order to show the relationship of the post-temporal, which in many species is coossified with the cranium, and to identify the different skeletal elements, as the parietals are usually missing.

The family Gasterosteidae in the following descriptions is represented by *Gasterosteus cataphractus* Pallas, from Japan. Specimens of *Eucalia*, *Apeltes* and *Pygosteus* were also examined. *Spinuchia*, the only other genus, was not at hand.

The family Aulorhynchidae is represented by *Aulorhynchus flavidus* Gill, from Puget Sound. *Aulichthys japonicus*, from Japan, was referred to. These are the only genera of the family.

The family Aulostomidae is represented by *Aulostomus valentini* Lacépède, from the Hawaiian Islands. This is the only genus of the family.

The family Fistulariidae is represented by *Fistularia petimba* Lacépède, from Japan. The only genus of its family.

The family Macrorhamphosidae is represented by *Macrorhamphosus sagifue* Jordan and Starks (new species), from Japan. The only other genus of the family is *Centriscoops*, which was not seen.

The family Centriscidae is represented by *Aeoliscus strigatus* (Günther), from Japan. *Centriscus*, the only other genus of the family (and closely related to *Aeoliscus*), was also skeletonized and examined.

In each genus an abundance of material was at hand, and when characters could not be fully made out in one specimen others were used until a degree of certainty as to limits of bones and indistinct sutures was reached which would have been impossible with single specimens.

Among the mistakes that have been made in the osteology of the group from time to time (most of which have been many times repeated) are the following:

Dr. Cope,¹ besides speaking of the "presence of the interclavicles (which I find in all)," says "basis cranii simple; no tube."

The former statement is treated elsewhere in this paper. As to the latter, *Macrorhamphosus* has a double basis cranii with a well-developed tube or myodome. Both families of the Gasterosteoida have the basis cranii rudimentary in bone but completed in cartilage. Both families of the Aulostomoidea have the basi-sphenoid bridging the anterior edges of the prootics above the rectus muscles of the eye, but with no tube in continuation. This character has not the value Dr. Cope placed upon it, as Dr. Gill has shown.

Dr. Gill, in his key to the families of these fishes,² includes Gasterosteidae and Aulorhynchidae under the character "pubic bones connected with scapular arch." In *Aulorhynchus* the pubic bones, though close behind, and slightly between the posterior part of the shoulder girdle, are not attached nor even in contact. In *Gasterosteus* a process from the shoulder girdle overlies the pubic bones slightly, but the integument and even the silvery pigment of the body is interposed between them. The pelvic girdle is easily movable, independent of the shoulder girdle. In *Eucalia* the pelvic does not nearly touch any part of the shoulder girdle.

Dr. Gill³ says that the "palatine bones are directly articulated with the quadrate without the intervention of the pterygoids. In *Fistularia* it appears so, as the suture between the quadrate and the pterygoid which extends forward is difficult to make out. Prolonged maceration, however, always separates the quadrate from the pterygoid. In a small specimen bending the bones in this region often opens the suture.

In *Aulostoma* the suture is conspicuous in the same place that it is in *Fistularia*, but there is no anterior element (palatine) apparent. An examination of the cranium, however, will show that the palatines have become ankylosed to each other and to the cranium at each side of the ethmoid. The pterygoid lies at each side of them but slightly attached. They hook over the maxillaries slightly as is typical.

¹ Observations on the Systematic Relations of Fishes, Proc. Amer. Asso. Adv. Sci., 1871, p. 317.

² Proc. Acad. Nat. Sci. Phila., 1884, p. 156.

³ Johnson's New Universal Cyclopedia, III, p. 801.

It is not apparent why Dr. Günther¹ should write, referring to the *Fistulariidae*, "ventral fins abdominal, separate from the pubic bones, which remain attached to the humeral arch." The "interclavicles" might easily be taken for pubic bones, but the ventral fins are attached directly to well-developed pubic bones.

Dr. Günther,² referring to *Eoliscus (strigatus)* as seen externally, makes the following statement: "The horizontal portion of the humerus,³ which is visible externally, is of moderate length, rather broad at its middle, and obliquely truncated behind; the coracoid, which is situated immediately below, has its basal portion not styli-form, but is broad like the humerus above." He has evidently taken the process of the clavicle for the hypercoracoid and the supraclavicle, including, possibly, the ankylosed plate above, for the clavicle.

Drs. Jordan and Evermann⁴ give the number of "pectoral ossicles" (actinosts) in *Fistularia* as three. There are four, as usual, the upper one closely attached against the hypercoracoid.

The Hemibranchs certainly do not deserve coordinate rank with the *Acanthopteri*, but should be included as a suborder under them, coordinate with the *Percosoces*. Probably the Synentognath fishes should also be so included.

A representative of each of the four Synentognath families has been examined as follows: In Belonidae, *Tylosurus fodiator* and *Tylosurus marinus*; in Hemiramphidae, *Hyporhamphus unifasciatus*; in Scombresocidae, *Cololabis saira*; in Exocoetidae, *Cypselurus californicus* and *Cypselurus agoo*. They show relationship to the Hemibranchs in possessing the following characters: Exoccipitals not united over the basioccipital;⁵ parapophyses developed on all abdominal vertebrae; postclavicle absent (absent only in some families of Hemibranchs); supraclavicle very small⁶ (in all but *Cololabis*, in which it is absent); post-temporal, when present, usually simple⁷ (absent in *Cololabis*, forked in *Tylosurus*); parietals absent⁸ (absent in all the Hemibranchs except

¹Cat. Fish. Brit. Mus., III, p. 529.

²Idem., III, p. 528.

³Dr. Günther in his Catalogue of the Fishes of the British Museum, p. 532, calls the clavicle of Parker the humerus, and in his Introduction to the Study of Fishes he calls it the clavícula. In the catalogue he calls the hypercoracoid of Gill the coracoid, and in the Study of Fishes the scapula.

⁴Fishes of North and Middle America, Bull. U. S. Nat. Mus., No. 47, p. 756.

⁵I put but little weight on this character, but give it for what it may be worth. It is not an uncommon condition, especially among the lower fishes, while the opposite seems to be the rule among the higher.

⁶Cope says: "Epiclavicle (=supraclavicle) not distinct." Systematic Relations of Fishes, Proc. Amer. Asso. Adv. Sci., 1871.

⁷Said by Cope to be "slender, furcate."

⁸Said by Cope to be "very much reduced." *Cypselurus* and *Hyporhamphus* appeared to have small parietals, but maceration of the specimens proved the contrary.

the Gasterosteoidea). The Syntognaths are at once separated from the Hemibranchs by the united inferior pharyngeals and the absence of fin spines, as well as by numerous minor characters.

The Hemibranchs show relationship with the Percesoces¹ in having the parapophyses developed on all the abdominal vertebrae; in having the supraclavicle, when present, small; in not having the exoccipitals united above the basioccipital; and in having the supraclavicle, when present, reduced in size. *Fistularia* and *Aulostomus* have processes running backward from the epiotics, which are strikingly similar to the epiotic processes possessed by all the Percesoces. Though they serve the same purpose (that of muscle attachments) in both, they are somewhat different in character, being in the Percesoces processes from and of the epiotics, while in the Aulostomoidea they are joined by ligaments to the epiotics. The Hemibranchs easily stand apart from the Percesoces in having no opisthotics and usually no parietals; in having the post-temporals simple, not typically forked; and in having the postclavicle composed of a single piece when present (composed of two pieces in the Percesoces).

Dr. Gill in his excellent paper,² though evidently having few internal characters at his command, has left little to be added in the arrangement of the Hemibranchiate families.

Gasterosteus and closely related genera are the most generalized of the Hemibranchs. They are the only ones in the group having the following typical characters: Anterior vertebrae unmodified; suspensorium and mouth normal; ribs typical; post-temporal approaching the normally forked condition, and parietals present (the last a superfamily character.)

Dr. Gill³ has pointed out how the tube-mouthed forms have descended in an unbroken line from *Gasterosteus* through *Spinachia* and the family Aulorhynchidae, these constituting the superfamily Gasterostoidea.

The Gasterostidae and Aulorhynchidae should perhaps be regarded as a single family, but following the lead of the above authority, they are here kept separate, though the latter family is regarded "simply as a convenient one at the most."

Between the other families occur wider gaps, that are more or less difficult to span.

The Fistularidae and Aulostomidae are well placed in the same superfamily. They show in a marked degree how two families of undoubtedly close relationship having many characters in common can still

¹In each of these characters *Sphyræna* is excepted. It seems to be a very much more generalized form than the other members of the Percesoces.

²On the Mutual Relations of the Hemibranchiate Fishes, Proc. Acad. Nat. Sci. Phila., 1884, p. 154.

³Proc. Acad. Nat. Sci. Phila., 1862, p. 233.

diverge very widely and have many characters radically different, as may be seen by referring to the diagnosis here included.¹

It is more difficult to see just where the family *Macrorhamphosidae* comes in, whether it is higher than the *Aulostomid* fishes or has not departed so far from its parent stem. It is an offshot in another direction. It certainly is not so highly specialized as the *Aulostomid* families with their anterior vertebrae and parapophyses ankylosed; their weak or absent spinous dorsal and their peculiarly modified basioccipital condyle. It seems well placed above them, having a well-developed spinous dorsal and the anterior vertebrae, but slightly enlarged and normally articulated.

The family *Centriscidae* shows evidence of having come from somewhere along the *Macrorhamphosidae* stem, but so far back and along such different lines that the evidence is not satisfactory. It is much more highly specialized.

DIAGNOSIS OF THE HEMIBRANCHII.

Opisthotics absent; parietals usually absent; exoccipitals never meeting over surface of basioccipitals; myodome usually absent or rudimentary, sometimes present; post-temporal never typically forked, sometimes a ganoid plate with an inner process, sometimes united by suture to cranium; a portion of the hypocoracoid sometimes ganoid, and appearing externally as a separate element ("interclavicle"); supraclavicle usually absent, small when present; postclavicle sometimes absent, composed of a single element when present; superior pharyngeals and usually elements of branchial arches reduced in number; inferior pharyngeals present, not united; four anterior vertebrae more or less elongated, sometimes united; bony dorsal bucklers coinciding with vertebrae developed anteriorly (hidden by scales in *Macrorhamphosus*); transverse processes developed on all abdominal vertebrae, usually largest anteriorly (in the *Aulostomoidea* united, and forming lateral shelves); snout more or less produced and tube-like, with a small mouth at its end; ventrals abdominal, sometimes anteriorly placed; hypocoracoid foramen sometimes formed partly by clavicle, always bordered by clavicle as seen from outer side, though hypercoracoid may or may not entirely inclose its foramen as seen from within.

GASTEROSTEOIDEA.

Parietals present; pterotic normally placed above prootic exoccipital suture; condyle of basioccipital normal, concave; basis cranii or shelf covering myodome incomplete, not nearly reaching to anterior edge of prootics, but completed in cartilage; basisphenoid absent;

¹ It is this element of instability in the coherence of characters that has made it so difficult to assign many forms to their proper groups. We do not know in what direction characters may be depended upon to show relationships.

ganoid plate ("interclavicle") of hypocoracoid more or less developed; postclavicle absent; actinosts small, without open spaces between; anterior vertebræ scarcely enlarged, not ankylosed; ventrals placed anteriorly; spinus dorsal represented by isolated spines; hypercoracoid foramen partly bordered by clavicle anteriorly; ribs developed.

a. Branchiostigals 3; ventrals with one soft ray each; snout conic, or but slightly tubiform; post-temporal and supraclavicle present; typical ribs present.

Gasterosteidæ.

aa. Branchiostigals 4; ventrals with 4 soft rays each; snout tubiform; clavicle attached to cranium by one of the lateral line series of bones; ribs (or epipleurals) terminating in lateral plates.....*Aulorhynchidæ.*

AULOSTOMOIDEA.

Parietals absent; pterotic interposed between and entirely separating prootic from exoccipital; condyle of basioccipital a round knob forming a ball-and-socket joint with atlas; basisphenoid bridging anterior edges of prootics above rectus muscles of eye making basis cranii appear double, but no myodome is in continuation; a long splint-like shield of bone is on each side of back attached in sockets of epiotics; hypocoracoid with a backward extending process ("interclavicle"); postclavicle present, simple; lower 3 actinosts subequal rod-like, with large open spaces between them; anterior 4 vertebræ elongate, ankylosed, and with coinciding bony dorsal bucklers above; ribs absent; ventrals placed at about middle of belly.

a. Skin smooth; body depressed; no dorsal spines developed; post-temporal suturally united to cranium; palatines normal, free from cranium; transverse processes normal.....*Fistulariidæ.*

aa. Skin with well-developed ctenoid scales; body compressed; spinous dorsal developed; post-temporal not united to cranium; palatines united to each other and to cranium; each transverse process behind fourth vertebra is formed equally by a process from each adjoining vertebra (or each end of each vertebra carries a half of each transverse process.....*Aulostomidæ.*

MACRORHAMPHOSOIDEA.

Parietals absent; pterotic normal in position; condyle of basioccipital concave; myodome present, well developed; basisphenoid small; no process or ganoid part (interclavicle) present on hypocoracoid; postclavicle present; actinosts without a space between them, the lowest elongated cutting into the hypocoracoid; post-temporal suturally united to cranium; supraclavicle coosified with clavicle; hypercoracoid entirely surrounding its foramen; anterior vertebræ somewhat enlarged, not united; transverse processes not united to form a lateral shelf; ribs absent; spinous dorsal well developed; ventrals placed at middle of abdomen.

Characters of the family included above.....*Macrorhamphosidæ.*

CENTRISCOIDEA.

Dermal armature connate with the internal skeleton, and developed as a dorsal cuirass in connection with the neuropophyses; six or more anterior vertebrae, extremely elongate, united; tail with its axis deflected from that of the abdomen by encroachment of dorsal cuirass over dorsal fin; branchial system feebly developed; parietals absent; pterotics normally placed; condyle of basioccipital concave; myodome absent; posttemporal united to cranium; supraclavicle present; foramen of hypercoracoid partly formed by clavicle; postclavicle present; lower actinost elongated, cutting into hypercoracoid; no open spaces between actinosts; ribs developed; ventrals at middle of belly; spinous dorsal developed below posterior spine of dorsal cuirass.

Family characters included above..... *Centriscoideae*.

THE SHOULDER GIRDLE IN DETAIL.

THE "INTERCLAVICLES."

The so-called interclavicles are here considered apart from the other parts of the shoulder girdle for purposes of closer comparison.

They may have been of different origin from the hypocoracoids, but if so they have lost all trace of ever having been a separate ossification. We can no more consider them as separate elements than we can divide other bones which are of both cartilaginous and dermal origin, and call each part by a different name. It is not true, as has been supposed, that all of the members of the order Hemibranchii have a differentiated part to the hypocoracoid.

In *Gasterosteus* the part termed interclavicle by Parker,¹ as seen externally, is the ganoid plate which bounds the lower edge of the silvery area in front of pectoral. (A process from the clavicle bounds it above.) It shows no sign of ever having been an ossification separate from the hypocoracoid. It is attached to the clavicle above, arching away from it and attached again at its lower end, thus inclosing an open space between. This is the typical arrangement of the hypocoracoid. The interclavicle may have been a plate of dermal bone that has become fused with the cartilage bone of the hypocoracoid beneath, but there seems to be no more necessity for giving it a separate name than there is for giving a separate name to the ganoid process from the clavicle.

In *Aulorhynchus* the lower outer edge of the hypocoracoid turns over slightly and forms the ganoid line which shows externally along the lower part of the side in front of the pectoral. This can certainly not be considered an interclavicle, and yet it differs but in degree from the interclavicle of *Gasterosteus*.

In *Fistularia* the interclavicle is the plate seen externally along the side of the breast and belly. It is larger than in any other member

¹Structure and Development of the Shoulder Girdle, Ray Society, London, 1867.

of the group. It runs forward to the lower end of the clavicle and attaches by simple suture, as the lower end of the hypocoracoid usually does. Posteriorly it runs far backward. It appears as a process from the hypocoracoid, there being no suture between them; ridges and internal plates of bone are continuous between them. We can but wonder why, if of dermal origin, it has not fused to the clavicle as well as to the hypocoracoid, the former a bone supposed to be like it, of dermal origin.

In *Aulostomus* there is a process extending backward from the hypocoracoid, which for most of its length is broken up into fine bristle-like filaments. It does not appear at all externally.

In *Macrorhamphosus* there are no interclavicles, unless the series of bony plates along the median line of the breast and belly be considered as such. They can certainly not be considered homologous with the parts so termed in *Gasterosteus* and *Fistularia*.

In the new genus *Eoliscus* Jordan and Starks, typified by *Amphisile strigata*, there is no part homologous with the interclavicles of the other forms, unless the posterior part of the hypocoracoid, which is partly divided from the anterior part by the encroachment of the lower actinost, be considered as such.

THE SHOULDER GIRDLE OF GASTEROSTEUS CATAPHRACTUS.

GASTEROSTEIDÆ.

The elements of the cranium are typical in number and arrangement except the opisthotics are absent. The parietals are widely separated by the supraoccipital. On the superior surface the epiotic articulates to the supraoccipital, the parietal, and the pterotic. On the posterior subvertical surface it articulates to the pterotic, the exoccipital, and the supraoccipital. The pterotics form the outer lower angle of the cranium. The articular facets of the exoccipitals are on a level with the middle of the basioccipital. The concave "centrum" of the basioccipital is exceedingly deep.

The post-temporal is a wide, nearly flat, ganoid bone, joined firmly and broadly (but not by dentate or inflexible suture) to the epiotic and pterotic. From its lower inner edge it sends a lower fork along the under part of the pterotic to where that bone joins the exoccipital, or to the place where the opisthotic typically is.

The supraclavicle is represented by a very small scale-like bone which is interposed between the clavicle and post-temporal, but not suspending the clavicle lower than it would be were it attached directly to the post-temporal.

The upper end of the clavicle turns backward around the hypercoracoid foramen. It shows exteriorly as a triangular ganoid plate behind the post-temporal, bounding the upper part of the round, naked space in front of the pectoral. The lower part of the clavicle runs obliquely downward and forward.

The hypocoracoid is attached broadly to the clavicle above, arches away from it, and returns to its lower end, inclosing a triangular space. Its lower ganoid part, the "interclavicle," is rough on the outer surface, but not otherwise differentiated from the rest of the bone.

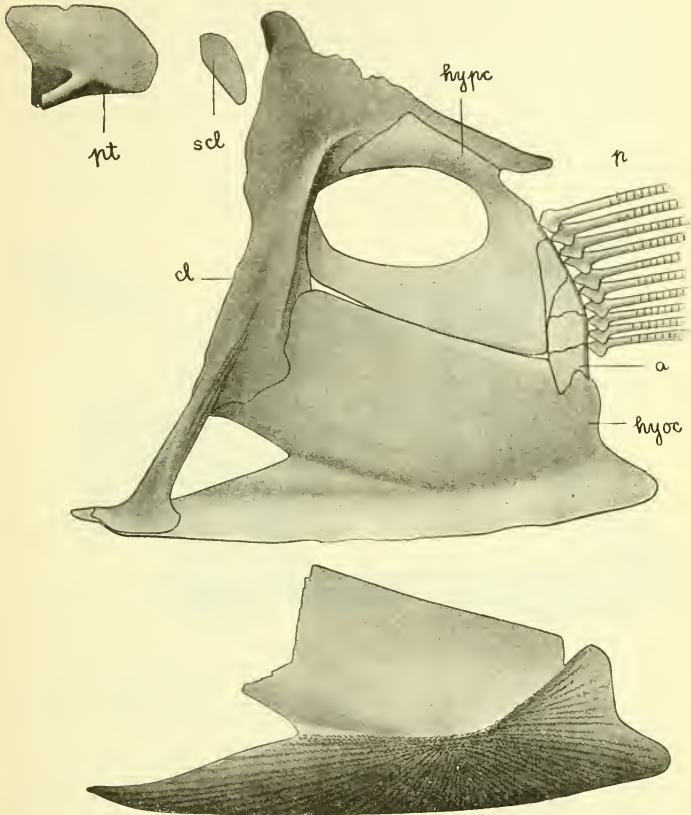


FIG. 1.—RIGHT SHOULDER GIRDLE OF *GASTEROSTEUS CATAPHRACTUS* FROM INNER SIDE AND HYPOCORACOID OF LEFT SHOULDER GIRDLE FROM OUTER SIDE. *a*, ACTINOSTS; *cl*, CLAVICLE; *hyoc*, HYPOCORACOID; *hype*, HYPERCORACOID; *p*, PECTORAL FIN; *pt*, POSTTEMPORAL, AND *scl*, SUPERCLAVICLE.

The hypercoracoid is assisted for a short space anteriorly by the clavicle in inclosing the large hypercoracoid foramen.

The actinosts are very small, about as wide as long, and have no openings between them. The lowermost one is attached to the hypocoracoid, the remaining three to the hypercoracoid.

THE SHOULDER GIRDLE OF AULORHYNCHUS FLAVIDUS.

AULORHYNCHIDÆ.

The posterior elements of the cranium resemble *Gasterosteus* in being more typical in arrangement than in other examples of the order. The pterotics form the outer lower angle of the cranium, and the articulations of the epiotics are the same.

There is but a single plate joining the clavicle to the cranium. It is one of the series of lateral line plates, bearing a tube continuous with the lateral line sensory system, and it is in no way differentiated from the rest of them. It is attached to the cranium over the pterotic

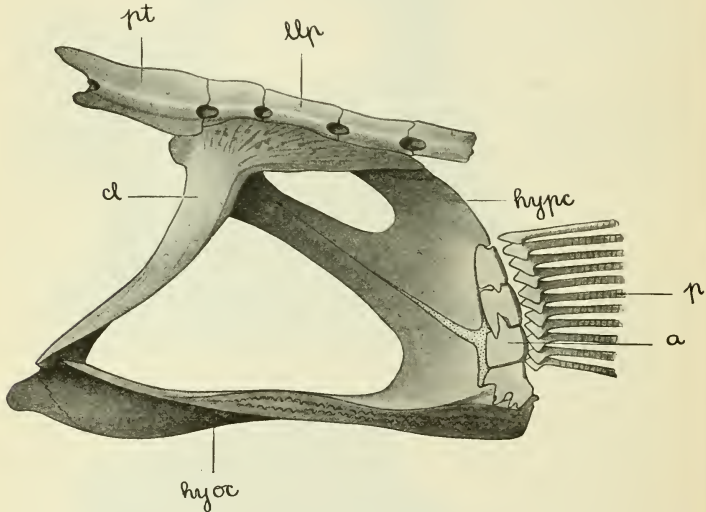


FIG. 2.—LEFT SHOULDER GIRDLE OF AULORHYNCHUS FLAVIDUS FROM OUTER SIDE. *a*, ACTINOSTS; *cl*, CLAVICLE; *hyoc*, HYPCORACOÏD; *hyc*, HYPERCORACOÏD; *llp*, LATERAL LINE PLATES; *p*, POSTCLAVICLE, AND *pt*, POSTTEMPORAL.

and the epiotic. Over its anterior end is a small bone bearing a branched tube of the sensory system, which directs one branch along the pterotic and another over the occipital region. It is typical in shape and function of the supratermporal.

The upper part of the clavicle turns backward in a triangular process as in *Gasterosteus*. The lateral line system of bones is attached along its upper edge and is continued backward along the side of the body. The lower part of the clavicle is slender and is inclined obliquely downward and forward.

The hypercoracoid foramen is bounded for a very short space along its anterior side by the clavicle.

The hypocoracoid is a very slender, widely forked bone. Its upper fork is attached above the middle of the clavicle, inclosing a large triangular space between. Its outer lower edge turns over slightly and forms the slender ganoid line along the lower part of the side in front of the pectoral.

The actinosts are very small, semiquadrate, and without openings. One and a half of them are attached to the hypocoracoid, two and a half to the hypercoracoid.

THE SHOULDER GIRDLE OF *AULOSTOMUS VALENTINI*.

AULOSTOMIDÆ.

The epiotocs are large, low, conical bones at each side of the supra-occipital. Each articulates to the frontal anteriorly, to the exoccipital

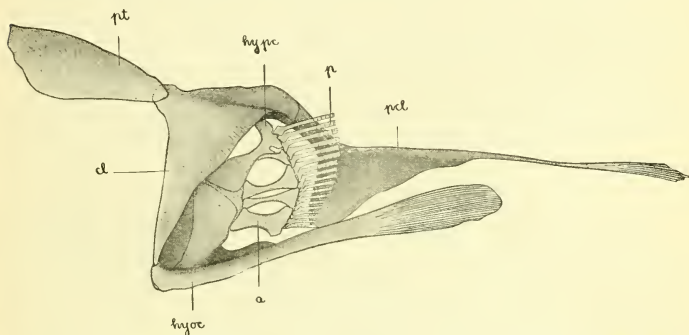


FIG. 3.—LEFT SHOULDER GIRDLE OF *AULOSTOMUS VALENTINI* FROM OUTER SIDE. *a*, ACTINOSTS; *cl* CLAVICLE; *hycr*, HYPERCORACOID; *hyc*, HYPCORACOID; *p*, PECTORAL FIN; *pcl*, POSTCLAVICLE, AND *pt*, POSTTEMPORAL.

posteriorly, and to the pterotic at its outer edge. The pterotic forms the posterior lateral angle of the cranium. It is anterior to the exoccipitals, which form, with the basioccipital, a posterior projection. The exoccipitals project downward on each side far below the condyle of the basioccipital. They meet broadly above the foramen magnum.

The post-temporal is not united with the head. It is a large ganoid plate seen externally behind the head, above and anterior to the triangular ganoid portion of the clavicle. It lies rather loosely against the cranium, over, but scarcely in contact with, the pterotic and epiotic. From its inner surface it sends a fork which rests rather loosely behind the part of the exoccipital that projects below the basioccipital.

The supraclavicle is absent.

The clavicle is a rather heavy triangular bone, as viewed from the outside. The anterior edge which borders the branchial cavity is

straight. From its anterior inner part a plate of bone folds back to support the hypo and hypercoracoid.

The latter is a thin plate, not strongly ossified. Through it and entirely within its edges is a very large fenestre, which from the outer side seems to be partly inclosed by the clavicle, as the hypercoracoid is attached flat against the inner surface of that bone.

The hypocoracoid is attached along its entire anterior edge to the clavicle without leaving the usual opening between. The lower edge is thickened and extends backward as a long process, which, growing thin posteriorly, is divided for most of its length into many bristle-like filaments.

The three lower actinosts are long and rod-like, with large spaces between them. The second and third are somewhat closer together than the others. The fourth is smaller, and is articulated closely against the upper outer end of the hypercoracoid. Two of them are above the hypercoracoid and two above the hypocoracoid.

The postclavicle is a broad triangular-shaped bone, with a process running obliquely from the upper corner for articulation with the clavicle, and the posterior corner prolonged into a long ray of bone.

THE SHOULDER GIRDLE OF *FISTULARIA PETIMBA*.

FISTULARIIDE.

The post-temporal is united to the cranium by dentate suture, forming an outer produced angle on each side wholly posterior to the pterotic. It is articulated laterally to the epiotic and the exoccipital, posteriorly slightly to the frontal and broadly to the pterotic.

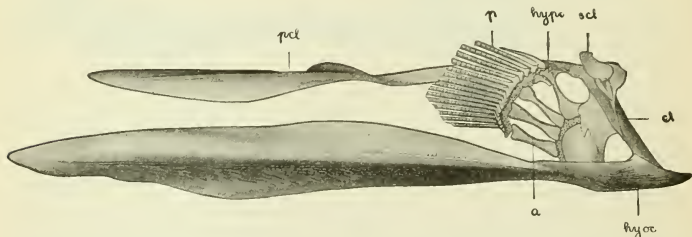


FIG. 4.—RIGHT SHOULDER GIRDLE OF *FISTULARIA PETIMBA* FROM OUTSIDE. *a*, ACTINOSTS; *cl*, CLAVICLE; *hyoc*, HYPOCORACOID, *hyc*, HYPERCORACOID, *p*, PECTORAL FIN; *pcl*, POSTCLAVICLE, AND *scl*, SUPERCLAVICLE.

Though the post-temporals appear to play an important part in forming the cranium when viewed from above, they form no part of the cranial wall, being only thin sheets of bone attached at their lateral and anterior edges. Were they removed the remaining elements would bear about the same relationship to each other as they do in the cranium of *Aulostomus*.

The supraclavicle is a short, scale-like bone, setting low on the clavicle, simply serving as a septum between the clavicle and post-temporal, and not suspending the former lower than it might be were it articulated directly to the post-temporal.

The clavicle is a complex bone, bending backward at its upper end to support the long simple postclavicle, which appears exteriorly as the upper lateral plate behind the head. It (the clavicle) borders nearly half of the fenestre, which typically is through the center of the hypercoracoid. It sends a wide process from its middle directly below this fenestre backward and downward to the hypocoracoid. Its lower end is straight, running obliquely forward to where it joins the lower end of the hypocoracoid ("interclavicle"), leaving an open space behind and between the forks of the hypocoracoid.

The hypercoracoid is little more than a rod of bone forming somewhat more than half of the fenestre, between it and the clavicle. It strongly resembles in shape and position the long, slender actinosts. The first pectoral ray works directly on it, as usual, and from this fact and its appearance one not knowing the cartilaginous origin of the bone might conceive the possibility of the hypercoracoid having originated from an actinost. This fancy is perhaps disturbed by the fact that the upper actinost is attached to its upper outer edge.

The other three actinosts are attached to the hypocoracoid or end in cartilage over it.

THE SHOULDER GIRDLE OF MACROHAMPHOSUS SAGIFUE, (NEW SPECIES.)

MACROHAMPHOSIDE.

The cranium is wedge-shaped as viewed from above. Posteriorly it is abruptly vertically truncated. The epiotics reach to the posterior edge of the cranium, and, bending sharply over, show about half of their surface above and half posteriorly.

The post-temporal is small and conical and ankylosed to the cranium, forming the outer lower angle. On the lower surface of the cranium it articulates with the exoccipital at its inner edge, and with the pterotic anteriorly; on the posterior surface, with the exoccipital and the epiotic; on the superior surface with the pterotic anteriorly, and with the epiotic at its outer edge.

The supraclavicle is so closely attached against the outer upper part of the clavicle that it is difficult to make out. It scarcely rises above the head of the clavicle.

The line of bony plates along the upper part of the sides is continuous over the clavicle, with a ridge on the post-temporal and the pterotic. These are doubtless homologous with the lateral line plates of *Aulorhynchus*.

A broad, thin plate projects backward from the middle of the inner edge of the clavicle and supports the hypercoracoid and the upper

part of the hypocoracoid. It laps over the hypercoracoid and borders the anterior half of the hypercoracoid foramen, as seen from the outer side of the shoulder girdle; but as seen from the inner side, the hypercoracoid entirely incloses its foramen, protecting it anteriorly, however, by a very narrow margin.

The postclavicle is a long, simple ray of bone carried by a projecting plate from the upper end of the clavicle.

The hypoclavicle is a very wide, thin plate, with an anterior rod of bone reaching to the lower end of the clavicle and inclosing a large fenestre. From just in front of the lower actinost a straight ridge

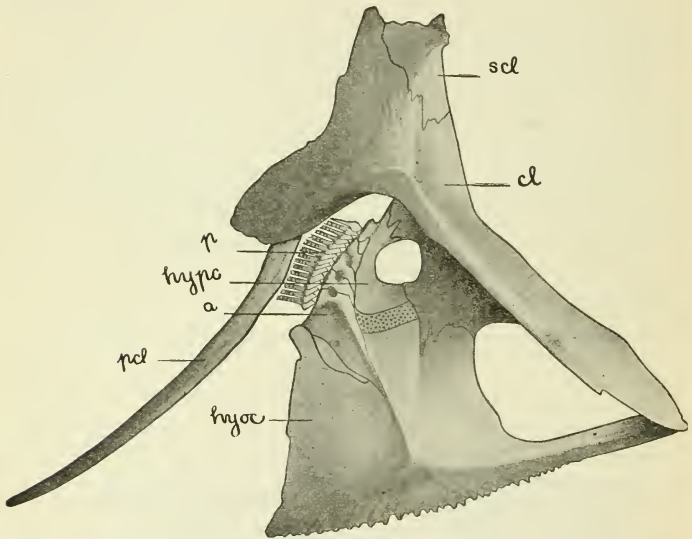


FIG. 5.—RIGHT SHOULDER GIRDLE OF MACRORHAMPHOSUS SAGIFUS FROM OUTER GIRDLE. FOR LETTERING SEE FIG. 1.

runs obliquely forward to near the lower edge of the hypocoracoid, where it turns at a sharp angle, and, following the edge of that bone, runs horizontally forward to its end at the clavicle.

The lower actinost is very much enlarged. It cuts a large space from, and continues down over the outer surface of, the hypocoracoid nearly to its middle. It ends in a sharp point. The others are somewhat pointed below, and grow smaller upward. There is a raised condyle on the hypercoracoid resembling the heads of the actinosts for the first rays of the pectoral to work on. All but the lowest actinost are attached to the hypercoracoid.

THE SHOULDER GIRDLE OF *ÆOLISCUS STRIGATUS*.

CENTRISCIDÆ.

The shape of the cranium resembles that of *Macrorhamphosus*, being wedge-shaped as viewed from above and vertically truncated posteriorly.

On its superior surface are five narrow wedge-shaped bones. The longest is the supraoccipital. About half of its length separates the posterior part of the frontals. On each side of it are the epiotics, of the same width but shorter. Anteriorly they cut a V-shaped piece out of the end of each frontal. The posttemporals are the most lateral and the shortest of these bones. They cut a V-shaped piece from the ends of the pterotics. On the superior-lateral surface of the cranium they are remote from the epiotics, but on the posterior surface they send a process up to them.

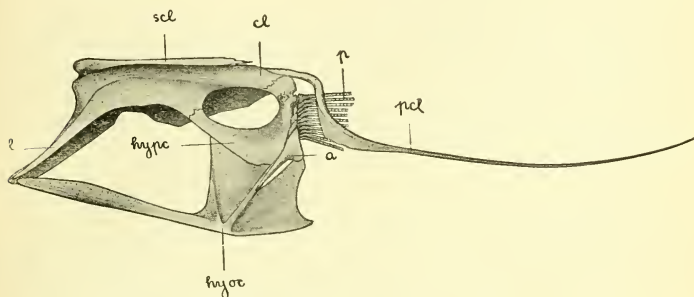


FIG. 6.—RIGHT SHOULDER GIRDLE OF *ÆOLISCUS STRIGATUS* FROM INNER SIDE. FOR LETTERING SEE FIG. 4.

The parietals and opisthotics are absent. The articular facets of the exoccipitals are at the extreme lower part of the cranium below the middle of the basioccipital condyle. The exoccipitals show no tendency to approach and join over the basioccipital.

The myodome appears to be wholly absent.

The supraclavicle shows externally as a long, narrow, ganoid bone, extending horizontally. It is enlarged anteriorly and is concave at its end for the reception of the end of the posttemporal. It laps over the edge of the clavicle somewhat and is firmly attached by a simple suture.

Directly above is a somewhat similar ganoid plate attached along the edge of the supraclavicle by a smooth inconspicuous suture. It extends farther back than the supraclavicle and appears to be one of the series of lateral plates. Both it and the supraclavicle attach by dentate suture to the wide lateral plate behind it. Above these are the median plates of the back.

The clavicle shows externally as a wide triangular plate reaching nearly to the pectoral, its anterior end descends bordering the gill opening as usual. From the inside the clavicle appears about three times longer than deep. From the inner upper edge a thin plate of bone turns down to the hypercoracoid.

The hypercoracoid does not nearly contain its foramen, but is assisted above by the inner plate of the clavicle.

A simple postclavicle is attached to the posterior end of the clavicle directly above the hypercoracoid. It is a very slender ray of bone bending sharply down to a level with the lower pectoral ray and thence reaching horizontally far back and ending as a fine filament.

The hypocoracoid is a nearly square thin plate, with a slender process running from its lower anterior corner at a right angle with its anterior edge to the lower end of the clavicle. From its upper posterior corner obliquely toward the lower anterior corner the lower actinost cuts in and subdivides it.

The upper ray of the pectoral works directly upon the hypercoracoid. Three of the actinosts are borne by the hypercoracoid and one by the hypocoracoid.

All of the inner elements of the shoulder girdle are extremely thin delicate plates, but slightly ossified, and generally strengthened by osseous ridges.

NORTH AMERICAN PARASITIC COPEPODS OF THE FAMILY
ARGULIDÆ, WITH A BIBLIOGRAPHY OF THE GROUP
AND A SYSTEMATIC REVIEW OF ALL KNOWN SPECIES.

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INTRODUCTION.

The present paper is the first of a series, now in course of preparation, on the parasitic copepods, based primarily on the large collection of this interesting group belonging to the U. S. National Museum, which has been placed in the author's hands for study. The great majority of the specimens came originally from the U. S. Fish Commission, and in addition all the unassigned material at the disposal of the Commission was turned over to the writer by Dr. H. C. Bumpus and Dr. Hugh M. Smith, to be added eventually to the National Museum collection. To Dr. Bumpus the author is also under obligation for the innumerable facilities in the way of collecting and studying living material which are always attendant upon a summer spent in the U. S. Fish Commission laboratory at Woods Hole.

Further acknowledgment is made of much valuable assistance rendered by Dr. Smith, who has placed every facility at the author's disposal, particularly of the inland stations of the U. S. Fish Commission, where no work of the kind has ever been done before; by Prof. Jacob Reighard, director of the station at Ann Arbor, Michigan, who discovered the new species *Argulus americanus*, and who has spared no pains to secure just the material asked for, and finally by Mr. Vinal N. Edwards, whose ability as a collector has placed so many other investigators under obligation.

Hence while these papers are to be primarily reports upon the National Museum collection, it is purposed to combine with them the notes and results obtained from the work at the U. S. Fish Commission, and to add also considerable that has come through private research, in order that they may be made as complete as possible.

Since this is the first attempt made in America upon this great crustacean group, it will, even at its best, of necessity be found deficient.

HISTORICAL.

In compiling the bibliography here presented it was quickly found that but a single species, the European *Argulus foliaceus*, had been studied at all completely. In fact, with the exception of three papers, one by Dana and Herrick (1837), another by Thorell (1864), and the third by Kellicott (1877), all the work done outside of mere systematic enumeration and description of species has been upon this one form. From it has been obtained practically all the knowledge hitherto possessed of the ontogeny of the entire group, with its important bearing upon their systematic position. Dana and Herrick (1837) do picture a larval *Argulus catostomi*, but the accompanying description is so brief as to have very little practical value. And Kellicott's interesting description of a larval *Argulus* (1880) had the misfortune to be published in a periodical that died at the end of the first volume, so that it has remained virtually unknown.

Moreover, both *A. foliaceus* and *A. catostomi* and Kellicott's *A. stizostethii* are fresh-water forms, and hence absolutely nothing has been known of the development of the large salt-water representation of the group, which, as we shall see, is very similar to that of Kellicott's species.

While it does not change the accepted ontogeny in any of its great fundamental principles, it will be found to be radically different in many of the details.

Although the entire group was thus for a long time represented by the single species, yet such a meager representation was more than offset by a remarkably wide distribution.

A. foliaceus was found quite commonly throughout the larger part of Europe, and quickly became well known. Singularly enough, subsequent discoveries have brought to light only two other European species. All the rest of the group, with some exceptions, have been found in American waters, and since the four new species here recorded are also American, it seems as if Kroyer's original statement that the great American continent is the proper habitat of the Argulidæ were likely to prove true.

But since more than half the entire group and eight out of the thirteen North American species are marine, Thorell's notion that this family is partial to fresh water must be set aside.

These facts ought at least to correct such statements as that made in Parker and Haswell's Text-book,¹ that *Argulus* "is an external parasite on fresh-water fishes—carp, stickleback, etc."

In the face of such facts it is all the more remarkable that no American zoologist has ever investigated the group.

Dana and Herrick (1837), Kellicott (1877 and 1880), Gould (1841), and Dana (1852) have each described new species. The first three

¹ First volume, p. 531.

descriptions are well written and quite complete, but the other two are almost worthless. Afterwards Dr. S. I. Smith, in the Invertebrates of Vineyard Sound (1874), described three new species and mentioned two of the others as probably occurring in the vicinity. These six descriptions, with an annotated List of Described Species, by Richard Rathbun (1884), comprise all the American literature upon the family.

No one since Jurine's day (1806) has compiled a bibliography of the Argulidæ, and but once (Thorell, 1864) has there been any attempt to present a review of all known species.

These facts at once warrant the following attempt, and guarantee that it will be of necessity more or less defective. But it is hoped that it may be of service as a basis for future work.

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ECOLOGY.

The problems of parasitism and its attendant degeneration are among the most interesting in the whole realm of ecology, and nowhere can they be studied to any better advantage than among the parasitic copepods.

We can find here every grade of parasitism and can easily follow the resultant effects in the habits and morphology of the parasites themselves. There are forms like *Argulus* which not only move about all over the body of their host, but also change frequently from one species of fish to another, and can even leave their host at will and swim about freely, sometimes for several days, before returning.

Retaining thus completely their powers of locomotion we should not expect nor do we find in them any degeneration, but rather such

a modification of the various organs especially used in parasitism—e. g., organs for clinging to their host, for piercing after blood, etc., as will the better adapt them to their specific use.

Then we find forms like *Caligus* which roam about freely over their host's body but do not apparently leave it voluntarily, though they can swim well enough when compelled to do so.

Here also we should not expect any marked degeneration, but rather a more complete adaptation of the various organs.

The first evidence of degeneration in this genus lies apparently in the inclination toward free swimming and not so much in the ability to perform it. In these two large genera, *Argulus* and *Caligus*, the males and females differ but slightly, and in some species of *Argulus* they may even be approximately of the same size. The fact that the Argulidæ do not carry their eggs about with them tends still farther to eliminate the sexual differences, while in the Caligidæ the presence or absence of the long egg pouches with the attendant modifications of structure constitute the chief sexual distinctions.

Not so, however, in forms like *Pandarus*, for here both sexes usually fasten themselves in one place and remain there for a long time. They are also so dissimilar in habits and structure that the males have been hitherto placed in an entirely separate genus (*Nogagus*), and the two sexes have been proved to belong to the same species only by being repeatedly found in actual coition. As is usual in such cases the female is the more degenerate and can only crawl about slowly; she is so heavy and clumsy that she can not swim at all.

Here then is evidence of structural degeneration, not very marked as yet, since fully developed swimming organs are retained though they can not be used in the adult state.

The male *Pandarus*, on the contrary, not only retains the locomotor structures but can use them, being able to swim about freely whenever occasion demands.

Again there are forms like *Philicthys* in which both the male and female have become practically incapable of locomotion, but are still found free in the mucous canals and sinuses of fishes. In them the locomotor organs are markedly degenerate having dwindled to mere stumps without joints or setæ.

And, finally, we find forms like *Chondrucanthus*, *Anchorella*, and *Lernæa*, in which the female is absolutely incapable of motion, being fixed in one position for life, while the male has dwindled to a mere pigmy adherent to some part of the female's body. The male can still move about somewhat but the female has lost all trace of every appendage except those which serve to fasten her to her host.

It is purposed in these papers to bring out as fully as possible such interesting gradations, the present paper, of course, being confined to the Argulidæ.

These are wholly external parasites, and though sometimes found upon the skin or the fins, they are usually confined to the branchial cavity of their host. They may be sought on the inner wall of the operculum or in the shallow pocket behind the posterior gill arch, but are never found upon the gills themselves except through accident. They cling to their host by means of the anterior maxillipeds which are modified for this purpose into sucking disks, somewhat similar to those upon the arms of Cephalopods. And by a sort of walking motion of these same suckers they are enabled to scuttle about quite rapidly over the fish's skin so long as it remains moist. But they are unable either to fasten themselves to, or to make any progress over, a dry surface. The posterior maxillipeds are also modified into clasping organs armed with hooks at the tips, spines, and setæ along the sides, and a large plate on the basal joint whose surface is usually raised into rough papillæ, and whose posterior edge is furnished with three stout spines whose chief use seems to be to act as a firm brace while the pointed proboscis is being thrust forward into the flesh of the host in order to draw blood. And finally the basal joints of the anterior antennæ are developed into a pair of enormous curved hooks which assist somewhat in holding the *Argulus* to its host. But their chief use is apparently to keep the anterior edge of the carapace firmly in position while the proboscis is being worked.

Whether the *Argulus* remain upon the outer skin or in the branchial cavity it is continually subjected to considerable friction as the fish moves about through the water, especially if its host happens to be a fish of rapid movements, and there is an absolute certainty that it will be washed off if its hold is loosened for ever so short an interval.

To lessen the friction as well as to get the full use of its grasping organs, the *Argulus* (and the same is also true of the *Caligidæ*) always takes a position with its own longitudinal axis parallel to that of its host, and its head pointing in the same direction. In this position all the grasping organs just mentioned work together to prevent any sliding backward over the fish's skin. In addition, the lower surface of the carapace, more particularly at the anterior margin and along the edges, is quite thickly studded with short triangular spines, which point downward and backward, and catch firmly in the skin of the host. At the bases of both pairs of antennæ, and in many species, just behind the mouth and between the bases of the second maxillipeds are paired spines much larger and stouter, which evidently serve a similar purpose.

Though there may be little evidence of degeneration in these Argulids, therefore, there are abundant modifications to suit their acquired parasitic habits.

Upon the death of its host an *Argulus* leaves the body at once if it be in the water and swims about actively in search of a new victim.

If the fish has been removed from the water the parasite usually remains within the branchial cavity since this retains moisture longer than any other portion of the external surface. It is no uncommon thing to find them alive there several hours after the fish's death.

Upon removal to an aquarium the Argulids are found to have retained their locomotor ability to a greater degree than any other group of the parasitic copepods.

And there is no distinction of sex in this, for males and females alike swim about with as much freedom and as great rapidity as any of the so-called free copepods. And their sucker feet enable them to rest by attaching themselves to the sides of the aquarium, to stones, algæ, or any other convenient surface, instead of by balancing after the manner of *Cyclops* and allied forms. In swimming, the four pairs of legs are used as the propelling agents, and are provided with a fringe of long plumose setæ for that purpose.

The abdomen is elevated at an angle of about 45 degrees with the plane of the body and seems to serve somewhat as a rudder, but the most of the steering is accomplished by a flexion of the thorax on the head carapace. The result is an easy gliding motion, wholly destitute of the jerkiness so characteristic of free copepods, and more resembling that of *Artemia* and *Branchipus*. They usually move with sharp turns in nearly every direction, often making a complete summersault, or turning upward and scuttling along back downward on the under side of the surface film of the water after the manner of some snails.

But though their ordinary motion is slow and easy, they can dart about with considerable rapidity upon occasion.

The length of the plumose setæ on the swimming legs seems to determine in great measure the rapidity of movement. In some species (*laticauda*, *versicolor*, etc.) the setæ are long and stout, while in others (*niger*, *alosa*, etc.) they are short and weak. It follows that the former species are capable of much more rapid and energetic motion than the latter.

In an aquarium these Argulids seldom exhibit the disagreeable propensity shown by the Caligids of crawling up as far as possible on the sides of the aquarium above the surface of the water and remaining there until dead and dried up.

On the contrary, they are easily kept in confinement and make docile and highly interesting laboratory material.

As a natural consequence of its freedom of motion, an Argulus is not as closely confined to a single species of fish as are the other copepod parasites. This fact is very apparent from an examination of the list of hosts following the description of each species (p. 704).

It is to be remembered in this connection that our knowledge of these American forms is as yet extremely meager. When some of them come to be known as well as the European *A. foliaceus*, the

host list will probably approach more nearly to the fabulous length which it has reached in that species, and may even include frog tadpoles or salamanders. At all events, it is pretty safe to predict that future observations will swell the list of hosts for nearly every species.

Not merely is the same species of *Argulus* found upon many different kinds of fish, but even the same individuals must of necessity frequently change their host. This follows as a result of their habit of egg laying.

Unlike other copepoda, the eggs are not carried about in sacs attached to the body, but are fastened to stones, to the bottom, or to any convenient surface. This necessitates the desertion of its host by the parasite during the period of egg laying, with little chance of ever finding it again, and with at least the possibility that another fish of the same species can not be found at once. This is especially true of the males, which are very ardent during the breeding season, as noted long ago by Jurine (1806), and often leave their host to roam about in search of a female. This desertion of the host at the spawning time is also confirmed by the origin of some of the material now under consideration.

The types of Professor Smith's new species are all recorded as taken apart from fish, two specimens of *A. laticaula* from among algae in August and another taken in a tow net early in September; a single specimen of *A. latus* taken in a tow net at the surface July 1, and three specimens of *A. megalops*, also in a tow net, July 8. Again, *A. foliaceus* is reported as having been found among *Anacharis* in a canal near Edinburgh, Scotland, on August 26. Six of the seven specimens were roaming about free, while the seventh was attached to a stickleback (1895).

And finally, the actual voluntary desertion of their host has been observed several times in aquaria, not merely when the *Arguli* were harbored by a different species of fish from that upon which they were found, but also when host and parasite were not separated at all, but placed in the aquarium together (1880). To be sure, even in the latter case, the surroundings were more or less artificial, but it hardly seems as if they could be enough so to account wholly for the restlessness exhibited by the *Arguli*. The fish very quickly quieted down and acted in a perfectly normal manner. That the parasites did not become equally quiet renders it very probable that there must be some foundation for such nomadic habits in their ordinary behavior under normal conditions.

It is not to be inferred, however, that an *Argulus* has no preference in the choice of a host.

On the contrary, it is probable that, like other parasites, each species prefers a certain kind of fish, or at the most a few different and probably closely related kinds.

But we may reasonably infer that, after withdrawal from its host for the purpose of egg laying, if an Argulus is unable to find another fish of the same species it is willing to take almost any temporary host obtainable, transferring afterwards as opportunity offers. In confirmation of such an inference the following experiments were made on *A. catostomi* and *A. versicolor* for fresh-water forms and on *A. laticauda* and *A. megalops* from salt-water fishes.

1. *A. catostomi* is usually found upon the common "sucker," *Catostomus commersonii* (Lacépède), from which it was originally obtained and named, but it also occurs, and in the author's experience even more abundantly, upon the chub sucker, *Erimyzon sucetta oblongus* (Mitchill).

It was desired to keep some of these parasites through the breeding season and also to ascertain, if possible, how they find and attach themselves to their host. But suckers are large and clumsy fish, difficult to transport, and requiring large aquaria. Added to this is the fact that the easiest method of obtaining them at the season when the Arguli are breeding is by spearing, and that this usually kills the fish.

For these reasons they were removed from the suckers and transported to the laboratory in jars. It was evident, however, that they could not be kept for any length of time without a host, and accordingly several species of fish were tried, the sunfish (*Lepomis gibbosus* Linnaeus), the dace (*Notropis megalops* Rafinesque), the yellow perch (*P. flavescens* Mitchill), and a species of minnow, locally known as the "mummichug." When the fish were placed in the aquarium, the Arguli very unexpectedly paid no attention to them and did not appear to recognize their presence in any way, and yet several days had elapsed before the fish could be obtained, and the parasites must have become quite hungry.

But they continued swimming about in their usual lazy, erratic fashion, often passing very close to one of the fish, but never seeming to realize that it might become a possible host, until they actually ran plump into it. Then, however, they made up for lost time, fastened themselves to the fish's body instantly, and eagerly sought for a place to pierce the skin and obtain some blood. On these small fish the bases and surfaces of the fins (including the tail), and the thin skin under the throat were favorite localities. They stopped at one of these places long enough to obtain a good meal and then passed forward and tried to crawl beneath the operculum.

If they failed in this on account of the small size of some of the fish they seemed content to remain upon the external surface, and in this way specimens were carried successfully through the breeding season and a fine lot of eggs obtained.

There was no hesitation in attaching to any of these fish, and there seemed to be no choice between the species.

2. *A. versicolor* lives upon the pickerel, *Lucius reticulatus* Le Sueur. Here again we have a fish so large as to be difficult of transportation alive, and very troublesome to keep in captivity.

But even the attempt was rendered impossible in the present experiment by the fact that the fish from which the parasites were obtained were taken through the ice in January and were all dead when examined. Accordingly the Arguli were transported to the laboratory, and this time some of the redbin shiners (*Notropis*) which had been used for bait were found to be the most available material for temporary hosts.

In this instance the parasites were placed directly upon the redbins. They attached themselves at once, seeming to prefer the neighborhood of the dorsal and ventral fins, and, so far as watched, making no attempt to crawl under the operculum.

They did not seem to irritate the fish perceptibly, although they could be plainly seen to crowd forward under the scales to pierce the skin. They were kept in this way more than two months, and had almost reached the breeding season when an unfortunate accident killed them all.

Remaining thus upon the external surface where they could be easily watched, it was seen that the individual parasites changed about considerably from one fish to another.

One of the redbins proved particularly attractive, and often had nearly all the parasites (15 in number) on his own body.

He was no larger than some of the others, but was very plump and vigorous.

This living upon minnows is in direct confirmation of the observations of Claus (1875) upon the two European forms, *A. foliaceus* and *A. coregoni*. But the present observations differed markedly from his in one respect; either these redbins were not as yet educated to the use of parasites as food, or they did not relish such a diet. Although they were fiercely hungry when obtained, having been kept without food since they were caught in the fall, no one of them took any notice of some Arguli which were placed free in the aquarium for that purpose.

Finally one of the parasites fairly rubbed against a redbin's nose in swimming about, and the latter, unable to resist such a call, opened his mouth and apparently swallowed the Argulus. But it was only apparently, for in a moment or two the Argulus was forcibly ejected uninjured, and no further attempt was ever made to swallow one. Indeed, none of them disappeared till the final accident which killed them all.

3. *A. laticauda* and *A. megalops* live upon many of our common salt-water fish, and some of them were desired for experiments similar to those tried upon the fresh-water forms.

But it would obviously be impossible to transport them with their

hosts for any distance inland. Through the kindness of Mr. Vinal N. Edwards many specimens of these two species were removed from their hosts, placed in fresh salt water, and sent through the mail from Woods Hole to Westfield, Massachusetts.

The *A. laticauda* were taken from eels and had evidently just finished their egg laying; the *A. megalops* were from flat fish (*Paralichthys*) and were still full of eggs. Some of the females laid upon the sides of the bottle on the way, and the remainder deposited their eggs after reaching the laboratory.

But how could any experiments upon a change of host be tried with these forms? No marine fish were obtainable alive, and if they could have been procured, sufficient salt water to keep them was manifestly out of the question so far inland.

It was remembered that these parasites infest many fish, like eels, salmon, herring, etc., which are migratory in their habits, and some which pass from salt into fresh water, or the opposite, during their migrations. It becomes an interesting question, therefore, whether the parasite is able to accompany its host through these changes or not.

It was determined first to try a change from salt to fresh water without the presence of any host whatever. Accordingly several specimens of each of these two salt-water species were placed in a dish of salt water, which was then slowly changed to fresh by the addition of a few drops of the latter at a time.

They gave apparently no attention whatever to the change, but continued to swim about in the fresh water as they had done in the salt. Indeed, they manifested so little appreciation of the change that another lot was transferred directly from salt to fresh water. These appeared a little irritated at first, but quickly recovered and manifested no subsequent difference in demeanor. Then a host was supplied them in the shape of a small minnow, to which they attached themselves readily and upon which they lived for several days.

These experiments would indicate very strongly that *Argulus* at least, among the copepods which infest the various salt-water migratory fishes, is capable of continuing upon its host as the latter passes up some fresh-water river in search of a suitable spawning place. It furnishes good proof also that the salt-water as well as the fresh-water forms are capable of changing about from one species of host to another.

In this connection it is well to recall the fact that the species *catostomi* was first discovered in the Mill River near New Haven, Connecticut, where the water is distinctly brackish (1837).

The same species was afterwards found by Gage (1886) in Cayuga Lake, Ithaca, New York, in perfectly fresh water. It has also been

found by the author in abundance in the Connecticut River and its tributaries near Springfield and Chicopee, far above tide water, and also in several small ponds and streams farther east in the State.

The ability to use almost any fish for a temporary host affords a reasonable explanation of the appearance of many species in the host lists whose presence would otherwise be difficult of explanation, as, for example, the frog tadpoles of *A. foliaceus*, etc.

It also readily explains why the Arguli should be found on mud-loving and bottom-frequenting species during the breeding seasons, while they rarely occur on the same species at other times. A study of the lists herewith presented (p. 704) will show that the place to look for these parasites during the breeding seasons is upon those fish which remain at or near the bottom where the Arguli go to deposit their eggs, while at other times the same parasites may be found only upon entirely different fish.

In consequence of such nomadic habits I heartily indorse Claus's remark that it is entirely unfitting to designate any species of Argulus by the name of the fish upon which it may be found. Later observation has always added other hosts and has often produced a long list like that for *foliaceus*, *laticauda*, and *megalops*. And in the majority of instances the first host has not proved to be the true one. Indeed, from the data and experiments here presented, it will be seen that in order to determine what species, if any, is to be regarded as really the host of an Argulus will require careful observation extending over at least a year.

The names already given to American species derived from the name of their host have been especially unfortunate. In Gould's *A. alosae*, *Alosa* was the name given by Cuvier to the shad upon which this parasite has not yet been found.

Again, the *A. catostomi* of Dana and Herriek proves to be far more common on *Erimyzon* than upon *Catostomus*.

The *A. funduli* of Kröyer is based upon a single specimen taken from a species of *Fundulus* (named *F. limbatus* by Kröyer) in the vicinity of New Orleans. As we have just seen, there is the possibility if not the probability that this parasite may have sought the *Fundulus* as a temporary host during or after egg laying. And the size of the female which is here for the first time described precludes any consideration of a species of *Fundulus* as its permanent host.

In contrast with these misnomers Smith's new species, *latus*, *laticauda*, and *megalops*, were fortunately based upon specimens taken at or near the surface, and whose hosts were wholly unknown. Profiting by these experiences the new species here described have been given names in no way connected with their host, and yet one of them (*versicolor*) has been found as yet only upon a single species of fish, *Lucius reticulatus* Le Sueur.

In spite of the fact that the Argulidae move about so freely and show almost no trace of degeneration, their food is exactly the same as that of the other parasitic copepods, namely, the blood of their host. They obtain this by means of a long eversible proboscis or dart, which is formed by a modification of certain of the mouth parts, and which they thrust through the skin, afterwards sucking up the blood as it flows from the wound. The base of the dart is continuous with the base of the regular mouth parts, from whence it extends forward between the bases of the two pairs of antennae, lying in a shallow groove which occupies the center of this ventral surface.

When swimming about freely the proboscis is withdrawn as far as possible and carried in the groove in a manner similar to that of the hemipterous insects. But upon the fish's body the anterior end is dropped down against the skin, into which it is pushed diagonally by a slight forward movement of the body assisted by its own eversion.

Naturally the parasites seek those portions of the body where the skin is thin, but more especially where the blood vessels are near the surface, such as the inner surface of the operculum and the fins. When fastened to the outside of the body of a scaly fish the scales naturally obstruct the passage of the dart. To obviate this the Argulus burrows beneath a scale with the anterior edge of the carapace, lifting the scale up and pushing the body forward until the dart is brought to the naked skin underneath. They remain in one position for an hour or more, as though the blood were obtained slowly.

As to the relation between parasite and host, it is not probable that the former ever become a serious menace to the life of the latter except under favorable conditions.

No matter how badly a fish may be infested with these pests it has a chance to get rid of them pretty thoroughly at least three times a year at the breeding seasons. Of course, if a fish for any reason has become debilitated and then happens to get an extra dose of parasites the results are likely to be fatal. But it is worthy of note that the Argulids prefer strong, healthy fish and are not often found upon sickly ones.

Their bodies are comparatively so small, are flattened so strongly, and are held so firmly to the fish's skin that they must occasion almost no inconvenience in the natural movements of their host.

When we consider the artificial propagation of fish, however, the conditions are entirely changed. Professor Smith long ago called attention to the subject of copepod parasitism in its special practical importance to all those engaged in raising fish confined in ponds or other restricted areas, especially in aquaria. The artificial surroundings always make more or less of a drain on the fish's vitality, and, since the numbers are restricted, there is a resultant concentration of the evil effects produced by the parasites. The very fact that the latter choose the strongest and most healthy fish is one of the worst things

that could happen, since it tends to keep the general tone down to the level of the weaker and poorer individuals. Hence the breeders of fish and the keepers of aquaria often find these parasites troublesome pests, as was clearly stated by the very first observer, Leonard Baldner (1666).

In the manuscript left in the public library at Strassburg, while speaking of what he calls the "pou des poissons" (*A. foliaceus*), he says that it is seldom found in the environs of Strassburg except upon trout, and that it frequently kills them, especially those which are kept in ponds.

In view of these difficulties the following experience will prove of interest and may become of practical value by suggesting an easy and effective means for keeping the pests within due bounds: In the town of Warren, Massachusetts, is a small pond artificially increased to a few acres in area by means of a dam. This pond was stocked with carp and bass several years ago. It is fed by two small mountain brooks, and having no other outlet except the sluiceway of the milldam, it furnished an excellent breeding place, in which the fish seemed to thrive well, but during the late summer and autumn of 1899 the fish began to die off in considerable numbers. Their dead bodies were found floating at the surface with no apparent signs of disease or injury, nor did careful and repeated examinations suggest any explanation of the epidemic. But the pond contained an abundance of a green floating alga which proved to harbor myriads of small crustacea, *Diphnia*, *Sida*, etc.

The devastation continued through the winter, and another visit was made in the spring in the hope of finding some clew.

This was just at the time suckers were running, and several of them were speared in a pool below the dam. On examining the walls of their gill cavities between 30 and 40 specimens of *A. catostomi* were obtained, many of them with ripe sexual products. These were taken home and kept in aquaria, where the females deposited their eggs, which hatched out a month later into a fine lot of larvæ. On showing the adults to the gentleman who owned the pond he said they were found on many of the fish caught, but were never considered specially harmful.

He also said that the brooks which fed the pond contained many suckers, most of which were infested with these parasites, a statement afterwards verified. It was determined to try the effect of a concentration of the parasites upon a few fish.

Accordingly 15 or 20 of the Arguli were put in a small aquarium and fish of various kinds from the pond were put in with them. These fish, which included roach, dace, and sun-fish, were put in one at a time, so that the entire number of parasites could concentrate upon each of them separately.

They fastened upon the ventral surface and upon the sides of the body near the operculum; the dace and roach resented the attack and thrashed around vigorously, but to no avail; the bream accepted the situation without protest. After remaining in the aquarium over night the dace and bream were found dead and floating around with exactly the same appearance as the dead fish in the pond. This, of course, suggested that if the number of parasites was sufficient in the pond, or if for any reason they concentrated upon a few fish, they might produce the fatality. The solution of the whole problem lay in the number of the parasites, and every effort was made to discover a reason for their abnormal abundance as well as that of the other small crustacea already mentioned. The reason came from a wholly unexpected source: as already stated, a fine lot of larvæ were obtained from the eggs laid in aquaria. One of the marked differences between the larva and the adult appears in the anterior maxillipeds. In the larva these terminate in an enormous barbed claw instead of a sucking disk. They are, therefore, clasping organs of a highly developed kind, but repeated efforts failed to induce the larvæ to use them for that purpose.

On the contrary, the latter continued to swarm near the surface of the water on the side of the aquarium toward the light, like other copepods, and paid no attention whatever to several fish which were put in with them as possible hosts.

Finally two small dace from the same pond were tried, but no more attention was paid to them than to the other kinds.

Not so with the fish however, for no sooner had they recovered from their fright at being handled than they turned round and ate up every last larva—several hundred in all.

Inquiries suggested by this action and made as soon as possible revealed the fact that for the three years previous to the fatality among the fish the proprietor of the pond had dragged it thoroughly with a seine and removed all the small dace and roach and sold them for live bait. Here was a satisfactory explanation of the abnormal abundance of copepods and cladocerans, and in it there is a plain suggestion that this question of parasitism is not such a one-sided affair as it appears at first sight. The adult *Argulus* may become a menace to the adult fish, but in its larval stages it no doubt often furnishes food for the young of the same fishes or of others.

It also suggests that a proper amount of protection for the small fish, such as dace, roach, etc., which inhabit our ponds and streams will be one of the most effective means of guarding against any formidable increase in the numbers of these parasites.

Especially is this true in the case of restricted areas like artificial fish ponds, hatcheries, aquaria, etc.; here every one of the conditions deleterious to the fish is advantageous to the parasite, and the latter is

always practically assured of a suitable host and assisted in any effort it may make toward concentration. These facts render it certain that if the breeding of Arguli is once started in such places it will rapidly assume dangerous proportions unless checked at the very beginning.

The introduction, repeated if necessary, of some of the small fish that naturally prey upon crustacean larvæ, could do no possible injury, and in the light of this investigation bids fair to prove an effective remedy.

SUMMARY.

1. The Argulidæ are external parasites, usually confined to the branchial cavity of their host.

2. They cling by means of the anterior maxillipeds, which are modified into sucking disks for this purpose, and by a walking motion of these same disks they scuttle about over the fish's skin so long as it remains moist. They can not fasten to a dry surface.

3. They always take a position with the long axis of their bodies parallel to that of their host and with their heads in the same direction. They are kept from slipping backward, as the fish darts through the water, by the sucking disks just mentioned, by large curved hooks on the bases of the anterior antennæ, by stout spines on the bases of both pairs of antennæ and often between the bases of both pairs of maxillipeds, by rough plates on the bases of the posterior maxillipeds, usually with three stout spines along their posterior border, and by short triangular spines all over the ventral surface of the carapace, but especially numerous along the anterior margin. All these spines point diagonally downward and backward, and at the slightest backward movement they catch firmly in the fish's skin, and, of course, the greater the pressure the more firmly they hold.

4. The Argulidæ retain their locomotor ability to a greater degree than any of the other parasitic copepods. Both males and females swim with an easy, gliding motion, free from jerkiness. The four pairs of legs serve as locomotor organs, and steering is accomplished chiefly by a flexion of the thorax on the head carapace, though the abdomen assists somewhat. The length of the plumose setæ on the legs seems to determine the rapidity of movement.

5. In consequence of its freedom of motion an Argulus is not confined to one species of fish, but can change its host at pleasure. Hence the host list is quite large for all the well-known species and will probably increase with further observation.

6. Both sexes, but especially the males, leave their host at the breeding season, since the eggs are not carried about, but are deposited on some favorable surface, usually at the bottom. Hence at least three times a year an infested fish has a chance to get rid of these parasites.

7. After leaving its host thus, if the *Argulus* can not readily find another individual of the same species it can live for a time upon almost any fish, or even upon frog tadpoles, changing afterwards as opportunity offers.

8. The species of *Argulidae* infesting migratory fish are probably able to change with their host from salt to fresh water or the reverse.

9. The food of these parasites is the blood of their hosts, obtained by means of a long evertible proboscis, which they thrust through the skin, afterwards sucking up the blood as it flows from the wound.

10. Under natural conditions it is not probable that the *Arguli* often become a serious menace to the life of their host; but in the artificial propagation of fish and in restricted areas, especially aquaria, they may, and often do, prove troublesome and sometimes kill off the fish. It has been proved that small fish—dace, roach, etc.—eat *Argulus* larvæ voraciously. Hence the protection of such fish in our ponds and streams and their introduction into restricted fish ponds and aquaria would probably prevent any serious multiplication of the parasites.

ONTOGENY.

The *Argulidae* are unlike other copepods, both free swimming and parasitic, in that the female does not carry her eggs about with her, but deposits them upon some convenient surface and there leaves them to care for themselves.

Claus states (1875) that *A. foliaceus* has three breeding seasons in the year—the first at the end of May or the beginning of June, the second during the middle or latter part of July, and the third in the latter part of September. Without being able to affirm, from actual observation of a single species throughout the entire year, that the American forms have similar breeding seasons, there are many facts which point strongly to such a conclusion in both the salt and the fresh water species.

1. *A. catostomi* certainly breeds in May and June, large numbers of eggs and larvæ having been obtained both by Dana and Herrick and by the author at that season.

2. *A. stizostethii* certainly breeds in August, Kellicott having obtained eggs (and larvæ) from ripe females taken from fish (*Stizostethium*, species) in the Niagara River at that season.

3. *A. megalops* and *A. laticauda* certainly breed in October, the author having received ripe females from Woods Hole at that season, from which were obtained eggs and subsequent larvæ.

4. Numerous very small *A. megalops* less than 2 mm. in length were obtained on August 20 and September 1, while *A. alosæ* of corresponding size were found on August 13. Since the *megalops* larva is nearly 1 mm. in length when hatched, it is evident that these young could not have come from the eggs of the previous year, but must

indicate a breeding season early in the year, corresponding to that of catostomi.

5. Females of the following species, full of eggs that appeared to be perfectly ripe, have been taken at Woods Hole at the dates given and are now in the collection of the National Museum: *A. megalops*, August 31, September 1, October 14, October 30, November 21; *A. laticauda*, August 14, August, October 20, 28, 30; *A. alosa*, August 13, September 24 and 27, October 5.

6. From a knowledge of the breeding habits which have just been given, the capture of males swimming about freely at the surface or isolated upon fish which they do not infest at other seasons in the year furnishes corroborative testimony to the breeding seasons.

Of such we find the following: *A. megalops*, male, from surface, July 8; two males from surface, August 31; one from a Minnow, July 14; one from Sea Robin, August 23. *A. laticauda*, one from among algae, August; one from Tom Cod, October 20; four from Skate, October 19; one from Bonnet Skate, August 9.

The cumulative evidence thus adduced makes it practically certain that the salt-water forms, at least, have three breeding seasons in the year, corresponding to those given by Claus for *A. foliaceus*. It would not be expected, of course, that the actual dates would correspond exactly.

The place chosen for egg deposition is usually a stone or other hard material, the glass sides in an aquarium being usually selected. Van Beneden writes (1883) that "la mère, au lieu de porter sa progéniture dans un sac qu'elle traîne avec elle, la confie successivement à l'un ou l'autre poisson, comme la coucou qui dépose des oeufs dans le nid d'un bec-fin, et le jeune Arguie, en naissant, jouit de toute sa liberté."

Jurine (1806), whose observations on the other habits of these parasites are so admirable, expressly says that he has never found any eggs upon the fish which serve as hosts for *A. foliaceus*, and his testimony has been corroborated by every one of the long list of collectors since his day, except Van Beneden (1891).

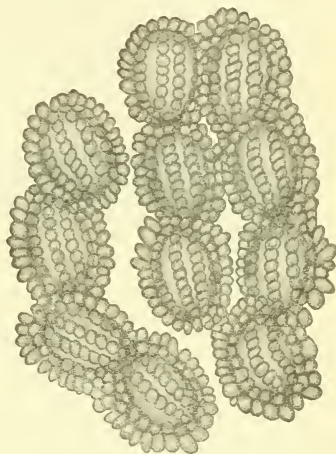


FIG. 1.—A SINGLE CLUSTER OF THE EGGS OF ARGULUS CATOSTOMI. ACTUAL SIZE OF ONE EGG 0.45 BY 0.3 MM.

Such a condition as the latter portrays, to be of any advantage to the Argulus, would necessitate that the larva fasten itself to the fish immediately upon emerging from the egg. In that case the expression "Jouit de toute sa liberté" would hardly convey the correct meaning. Van Beneden does not give this as his own personal observation, and it will require considerable additional proof before it can be received. The probability is strongly against it.

When a suitable place has been chosen by the female the eggs are deposited end to end in parallel rows, one egg at a time. The rows are quite short and may contain anywhere from 3 or 4 to 15 or 20 eggs, and there may be from 3 to 6 or 7 rows together. The female then rests for a while before depositing a similar lot in another place. Often in an aquarium the entire lot of several hundred eggs will be deposited close together on one side, but they are always broken up into these smaller lots determined by the intervals of rest.

As nearly as can be judged from a careful comparison of the statements of various authors with original observations, there seems to be

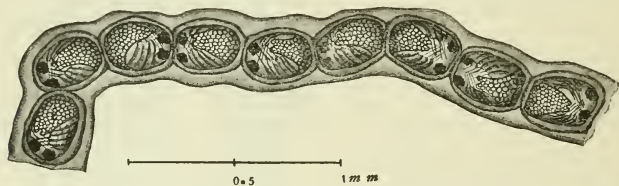


FIG. 2.—EGGS OF ARGULUS MEGALOPS ABOUT READY TO HATCH. ACTUAL SIZE OF ONE EGG 0.35 BY 0.28 MM.

a tendency in *A. foliaceus* toward a fewer number of rows (two being very common) and more eggs in each, while in *A. catostomi* the rows are more numerous and shorter, giving to the individual batches of eggs more of an elliptical outline (fig. 1).

In *A. megalops*, on the contrary, all the eggs observed have been laid in single rows, with from 6 or 8 to 20 or 25 eggs in each (fig. 2). Jurine (1806) has given us an admirable description of the process of egg-laying in *A. foliaceus*, so accurate that it has not since been altered in a single essential particular. I quote it in full.

Toutes les fois que l'argule-mère a pondu un oeuf, elle fait un petit pas qui avance son corps en lui donnant un peu d'obliquité: de sorte que le second oeuf se trouve nécessairement placé en avant et à côté du premier. En alternant ainsi ses pas, le troisième oeuf se trouvera dans la direction du premier, le quatrième dans celle du second, et ainsi de suite; de manière qu'ils seront disposés sur deux colonnes, dont la première comprendra tous ceux dont les nombres sont impairs, et la seconde ceux dont les nombres sont pairs. Telle est la marche que suivant ordinairement ces femelles dans leur ponte; cependant il arrive quelquefois qu'elles déposent leurs oeufs sur trois, quatre ou cinq colonnes, ou qu'elles les éparpillent; mais ce dernier cas n'a lieu que lorsqu'elles sont inquiétées. Il arrive encore que les femelles entrecourent leur ponte et qu'elles la font en trois ou quatre reprises: alors elles changent de place et se transportant ailleurs.

It would be expected that the method would differ in different species, and it actually does vary in several particulars when witnessed in *A. catostomi* and *A. megalops*.

In the former species the female does not twist from side to side nor do the eggs alternate in two adjacent rows, as described by Jurine.

In the deposition of hundreds of eggs no female was seen to deposit two rows at the same time, but only a single short row.

These eggs of *A. catostomi* are ellipsoidal, quite large (0.45 mm. by 0.3 mm.) and are yellowish white when first laid.

But they soon become dirty, turning first a darker yellow and finally a rusty-brown color. The thick jelly with which they are covered when they come out of the oviduct quickly hardens in the water and forms a dense covering, very difficult to break open without injury to the egg inside. But the chief characteristic is the form which this jelly envelope assumes. At first it is spread in an even layer over the entire egg, but the surface quickly breaks up into longitudinal grooves with sharp ridges between. The grooves may or may not twist a little spirally around the long axis of the egg, but the intervening ridges always crack transversely and separate into short masses which usually assume quite a perfect ellipsoidal form, the same as that of the egg itself.

These ellipses may be arranged end to end in a row, similar to the arrangement of the eggs, or they may be placed side by side, or may even stand out at right angles to the surface of the egg like rounded warts or papillæ (fig. 1).

On further hardening, the same grooving and breaking up into papillæ may appear on the surface of each of the original ellipsoids, so that such eggs come to have a set of doubly crenated ribs, a mark which will distinguish them wherever found.

The eggs of *A. americanus* resemble those of *catostomi* in that the jelly envelope breaks up similarly into longitudinal rows of papillæ, but there is never any double crenation. In addition to the rows of papillæ they are always from one to several much larger, irregular masses of jelly attached to each egg envelope.

The other species, *A. megalops*, is the first of the salt-water Argulids whose method of egg deposition has ever been watched, and the process is therefore worthy of a somewhat more detailed description. Through the courtesy of Vinal N. Edwards about a dozen females with ripe eggs were obtained from Woods Hole, on October 30, 1901.

These were sent by mail in a small bottle of salt water and were all alive when received; some of them had already begun to deposit their eggs on the sides of the bottle on the way.

The remainder of the eggs were secured on the sides of a small glass aquarium to which the Arguli were all transposed.

In this case also the female hunted for a suitable spot when about to

deposit her eggs. Having found one she crawled along slowly over it by the walking motion of her sucking discs. When she had advanced far enough to compensate for the length of her body she stopped and violently contorted and twisted her thorax and abdomen, bending them from side to side and backward and forward. During these contortions an egg could be seen descending the oviduct toward the opening between the posterior pair of legs. Just as the egg reached this opening the thorax was bent sharply upward (dorsally) away from the glass; at the same time the abdomen was bent sharply downward (ventrally) toward the glass, so that thorax and abdomen formed a right angle with each other, the angle being held some little distance away from the surface. Into the space thus formed the egg was protruded, being seized firmly on either side by the basal joints of the posterior pair of legs as soon as it emerged from the opening of the oviduct. The posterior lobes on these basal joints were pulled as far forward as possible and then drawn together, catching the egg between their inner surfaces and carrying it backward into the little space under the flexed thorax-abdomen. Here it was pressed for an instant against the support (glass) to which it adhered firmly.

The Argulus then moved forward a distance equal to the long diameter of the egg with its jelly envelope and the process was repeated. The eggs thus adhere to each other in rows as well as to the glass, each row containing ten or a dozen eggs and being usually quite straight. The process is rather slow, a little more than a minute (seventy seconds) being occupied in the deposition of a single egg. In this species one female did not lay more than 40 or 50 eggs, and often the last ones were deposited singly and scattered about indiscriminately.

It seems probable, however, that this number does not represent the entire batch of eggs, but that the females had deposited a part of them before being captured.

After the first one or two eggs are laid the abdomen of course has to ride up over them as the Argulus moves forward.

The base of the anal sinus rests upon the rounded upper surfaces of the eggs, which it fits snugly, while the lateral edges are bent down on either side. The abdomen thus curved over the eggs probably acts as a guide for the Argulus, enabling her to place the eggs in approximately straight rows.

Furthermore, it would seem as if the anal papillæ, which in *megalops*, as so often in other species, are situated at the very base of the sinus, might act as feelers, slipping over the eggs lengthwise and down into the hollows between them, enabling the Argulus to tell when she had moved forward just the right distance.

At all events, whether the rows are straight or crooked, the eggs are always the same distance apart.

It will be noted that this account differs considerably from that of Jurine. In the present instance, as in the case of *A. catostomi*, already cited, no female deposited her eggs in two columns, but every time they were arranged in a single row. This was due to the fact that the short move ahead, instead of being a one-sided affair, throwing the body at an oblique angle to the line of progress, was a uniform and even advance, the body remaining always parallel with the line of advance. All through the egg laying the females manifest considerable excitement; the legs, with the exception of the posterior pair, are moved incessantly and with great rapidity in the same way as when swimming. As soon as one row of eggs is finished the female darts rapidly about the aquarium for some little time, twisting and turning somersaults as if crazed. These motions gradually slow down and finally cease, when she begins to hunt for a new place in which to deposit another row of eggs. These observations, coupled with the fact that females with their ovaries only half full of ripe eggs have been repeatedly taken upon fish frequenting the bottom, make it reasonably certain that they do not deposit their eggs all at once, but at intervals, and in the meanwhile they may even obtain a square meal from some convenient fish.

The female carries sperm, obtained from previous copulation, in her abdominal pouches, and each egg is fertilized as it is laid. If one of the eggs be removed shortly after deposition and examined under a high power the spermatozoa can be plainly seen swarming around the jelly envelope.

Notwithstanding this method of fertilization, the egg laying excites the males even more than the females, and they dart about in a vain endeavor to get hold of some of the latter.

At first two species (*megalops* and *laticauda*) were mingled in the same dish; all of the females that were laying were *megalops*, while most of the males were *laticauda*. But this fact did not seem to make any difference; the *laticauda* males were as much excited as those of *megalops*, and, neglecting the females of their own species, which were quiet and had finished their laying, they made every effort to seize the *megalops* females; but, together with the *megalops* males, they were constantly repulsed. Evidently the copulation takes place previous to egg laying, and the female relies wholly upon the sperm stored up in the seminal pouches.

These eggs of *A. megalops* are ellipsoidal, like those of *foliaceus* and *catostomi*, but are not as large, being only 0.35 mm. long and 0.28 mm. wide, and yet we shall presently see that the larva which emerges from them is one of the largest yet described.

The eggs are light yellow when first laid, afterwards becoming dirty and brownish, but never as dark as those of *catostomi*.

The eggs of *A. stizostethii* are more nearly spherical, about 0.41 mm. in diameter, and are milk white when first laid, soon changing to light yellow. In both species the eggs remain smooth till hatched, never showing any crenations.

The long diameter of the egg becomes the longitudinal axis of the larva, but all the larvæ in the same row are not arranged with their heads in the same direction. Every here and there one will be found reversed so that heads of adjacent ones come together, as is common in the egg strings of the Eucepods. Curiously enough in this lot of *megalops* eggs it seemed to be quite regularly the fourth ones which were thus reversed, but probably such regularity was accidental.

The number of eggs deposited by a single female is given as 100 by Claus (1875) for *A. foliaceus*, and as 400 by Jurine for the same species; as 1,200 by Dana and Herrick (1837) for *A. catostomi*, and as 50 to 300 by Kellicott (1880) for *A. stizostethii*.

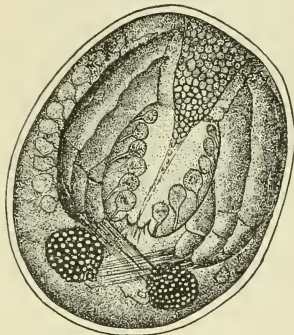


FIG. 3.—LARVA OF ARGULUS MEGALOPS JUST READY TO HATCH.

black eyes first become visible. The egg then rapidly clears and it can be plainly seen that the body of the larva is folded upon itself, the abdomen and the posterior thorax being turned forward along the ventral surface of the head thorax, while the legs are folded forward and inward with the long rowing setæ crossing one another on the mid line (fig. 3).

The time required for hatching varies greatly. In *A. foliaceus* it is given as about four weeks (Claus), and as thirty-five days (Jurine); it is nearly the same for *A. catostomi*, thirty-five days (Dana and Herrick), and from twenty-eight to thirty-five days in the author's experience.

This time proves to be a sort of golden mean in Argulus development, other species varying from it in both directions. The period for *A. americanus* is only about half as long. Eggs which were laid on June 7, 1902, and which were sent to the author by Professor Reighard from the U. S. Fish Commission station at Ann Arbor, Michi-

In the author's experience the largest number obtained from a single female was between 500 and 600 for *A. catostomi* and 65 for *A. megalops*. But it is probable in the latter case that the females had already deposited some eggs before being captured, since the ovaries were not more than half full.

After being deposited the eggs become opaque and no trace of the development can be seen through the jelly envelope until two or three weeks before hatching, when the

gan, began to hatch on the 25th, a period of only eighteen days. And yet, from actual tests, the temperature of the aquarium did not rise above 65° F. during that time.

For *A. megalops* the time is much longer: the eggs obtained from Woods Hole were laid October 30 and 31; they did not begin to hatch until December 12, and the larvæ had not all emerged before December 30 (sixty days), nearly double the time required for the two first species. And there is another consideration which makes this disparity even greater than it seems at first sight. No statement of the conditions under which development took place is made by any of the authors save Kellicott (1880). Dana and Herrick, however, do mention (1837) that the female of *A. catostomi* laid her eggs upon the sides of the aquarium, and it is to be presumed that they remained there until hatched. Probably also the times recorded by the other authors were obtained from eggs kept in aquaria.

Such at least is the case with the eggs of both *catostomi* and *megalops* observed by the present author. And in both instances the water of the aquarium stood at about the same temperature (72° F.) as that of the room in which it was kept.

This would not be much of a change from their normal environment for the eggs of *catostomi*, for they were not laid till May 14, and were kept through June into July, hatching from June 11 to 20. The temperature of the water in the pond from which the females were taken must have risen during that time to within a comparatively few degrees of the room mentioned. But in the case of *A. megalops* there was a radical difference in the environment; these eggs were taken from the open ocean on October 30, and kept through November and into the latter part of December. Hence a temperature of 75° would be at least 30° or 35° higher than that of the salt water at Woods Hole during those months. This would mean, of course, that the eggs developed much faster than in their normal surroundings, so that we must add eight or ten days to the period just given before comparing it with the other species.

Hence incubation is fully twice as long in *megalops* as in *foliaceus* or *catostomi*. But even this record is surpassed by that of *A. stizostethii*. Kellicott records (1880) that the eggs laid in his aquarium on August 28 did not show the dark eye dots until October 5, and did not begin to hatch till November 17, a period of eighty-one days! Here the author distinctly states that the tank was kept at the temperature of the room, and hence something would need to be added to even such an enormous period as this before it would fairly represent the length of incubation under normal conditions. It is also stated that these eggs were kept out of the light, and Kellicott thinks that this influenced the incubation. Possibly it might offset the increase in temperature, but we must remember that in depositing her eggs under normal conditions the female Argulus must needs often get them in the shade. It

would seem fair, therefore, to allow the record to stand as given, so that this incubation period would be a little longer than that of *megalops*.

There are other considerations also which make it practically certain that the incubation period of these two species would be of about the same length, and longer than that of *foliaceus* and *catostomi* (p. 660).

Both Jurine and Claus have given a detailed account of the larva of *foliaceus* and the various molts through which it passes.

Claus calls especial attention to the fact that the egg contains a relatively large yolk, and that the embryo attains a correspondingly unusual size and advanced development before hatching. This occasions the period of increase in the prenatal development as compared with other parasitic copepods.

If this be true of *foliaceus* and *catostomi*, we would naturally infer that in *megalops* and *stizostethii*, with their incubating period twice as long, the larva must be even further developed, and such we shall find to be the case.

In the following account of larval development the facts in relation to *foliaceus* have been taken from Jurine (1806), Leydig (1850), and Claus (1875), those in regard to *stizostethii* from Kellicott (1880), while those in reference to *catostomi*, *megalops*, and *americanus* are from original observations. It is hoped soon to publish a full description of these latter larvæ.

On first issuing from the egg the larvæ of *foliaceus* and *catostomi* bear a striking resemblance to a partly developed Caligus, as noted at some length by Claus.

We find a shield-shaped anterior portion of the body corresponding with the cephalo-thorax in Caligus, three free segments corresponding with the second, third, and fourth thoracic segments in Caligus, and a large abdomen carrying papillæ armed with setæ, corresponding with the papillated abdomen of the Eucepods.

In the larvæ of *A. megalops* and *A. stizostethii* the resemblance is not quite so apparent, chiefly on account of their more advanced development, but we can still distinguish the same regions easily. (Plate VIII.) Hence the nauplius, the metanauplius, and even the earlier cyclops stages are passed by these Argulus larvæ inside the egg, and they come forth in one of the more fully developed cyclops stages. All the segments and appendages which are to appear in the adult are present at birth, and in addition the *foliaceus* and *catostomi* larvæ have extra temporary appendages in the form of a pair of mandibular palps, which are used as locomotor organs up to the first molt, and then disappear.

We should expect larvæ so very well developed at birth to be much larger than the ordinary crustacean nauplius, and they rather exceed our expectations. The larva of *foliaceus* is 0.6 to 0.75 mm. in length, that of *catostomi* 0.7 to 0.8 mm., while the *megalops* larva is 0.8 to

0.85 mm. long, and the larva of *stizostethii* reaches almost 1 mm. (0.98). And this, too, in spite of the fact that the adults of *megalops* and *stizostethii* are smaller than those of *catostomi* and *foliaceus*.

That the sizes should be thus reversed in the larvæ is further good proof of the difference in their relative development, i. e., not only does the greater similarity of the appendages to the adult form attest the more advanced development of the *stizostethii* larva, but its body is actually nearly twice as large as that of the *foliaceus* larva.

All the larvæ have the general shape of the adult, save that in *foliaceus*, *catostomi*, and *americanus* the body is somewhat narrowed posteriorly, while the anal papillæ are much larger and terminal instead of basal. The carapace is relatively broad and barely covers the bases of the first swimming legs.

In *catostomi* the width of the larval carapace is relatively less than that of the adult, but in the other species it is practically the same. Its border is fringed with fine cilia, among which are scattered stouter, seta-like tactile organs which are much larger than the cilia and about twice as long.

The free thoracic segments diminish much more rapidly in these three larvæ than in the other two species, but each segment bears a pair of swimming legs or their rudiments.

The abdomen in the three species just named is also very narrow, almost triangular in shape, and terminated by the large anal papillæ. In the *megalops* and *stizostethii* larvæ, on the contrary, the abdomen is as wide as the last thoracic segment, is broadly ovate in form, and in the *megalops* larvæ is terminated by two short, bluntly acute lobes, with the anal papillæ at the base of the intervening sinus. In *stizostethii* the abdomen is abruptly truncated posteriorly and the anal sinus is so shallow that there are practically no lobes at all, but the anal papillæ are situated close to the anus, and therefore must be regarded as basal rather than terminal, like those of *megalops*, to which they also correspond in size.

The first antennæ, and in *megalops* and *stizostethii* the second also, have already assumed nearly their permanent form.

In all the species the first antennæ are three-jointed,¹ the basal

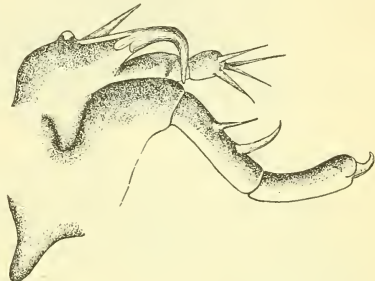


FIG. 4.—FIRST AND SECOND ANTENNÆ OF NEWLY HATCHED LARVA OF ARGULUS MEGALOPS.

¹Kellicott says (1880) that the first antennæ of *stizostethii* are four-jointed, but they are really the same as those of the other species. The apparent difference comes from his regarding the basal joint as double rather than single, in which case these first antennæ would be four-jointed in all the species.

joint being very large and flat, furnished with large sickle-shaped hooks on its lateral, and smaller ones on its anterior, margin, and evidently functioning as an organ of prehension.

The two terminal joints are small and armed with delicate tactile bristles, and they just as evidently function as tactile organs. On the bases of both pairs of antennæ in all the larvæ are found stout spines directed backward as in the adult (fig. 4).

In the larvæ of the first group the second antennæ are very different in form from those of the adult, and serve as one of the two principal locomotor organs. They are very much elongated, extending

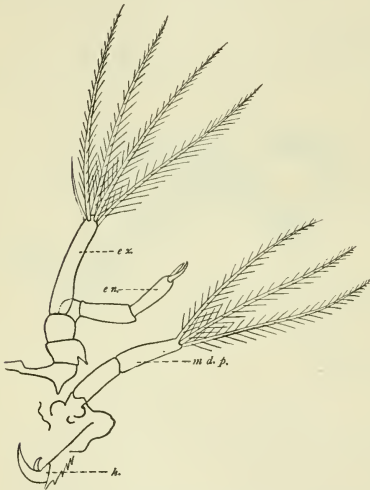


FIG. 5.—SECOND ANTENNA AND LABIAL PALP OF NEWLY HATCHED LARVA OF ARGULUS FOLIACEUS (MODIFIED FROM CLAUS). *ex.*, AND *en.*, EXOPOD AND ENDOPOD OF THE SECOND ANTENNÆ; *h.*, HOOK CONNECTED WITH BASE OF THE SAME; *md. p.*, TEMPORARY MANDIBULAR PALPS.

far beyond the carapace, and are made up of three parts, a 2-jointed basipod arising just posterior to the eyes, each joint being armed with a short spine, a stout endopod also 2-jointed and tipped with a curved spine, and a 1-jointed exopod bearing at its tip four long plumose setæ and a short thumb-like one on the inner side. These setæ can be approximated or separated at pleasure (fig. 5).

In contrast with these the second antennæ of the *megalops* and *stizostethii* larvæ are of ordinary length and consist of a good-sized basal joint extending back about opposite the center of the eyes, where it is armed near the median line with the usual blunt spine, a long

middle joint armed with two spines on its anterior surface, and a short terminal joint tipped with a stout hook.¹

When straightened these antennæ reach considerably beyond the border of the carapace, but the latter nearly covers them when they are partly folded, the position in which the larva usually carries them. Hence they can not take any part in locomotion.

Next in order posteriorly we find in our three larvæ a pair of ap-

¹ Kellicott says that the second antennæ in *stizostethii* are four-jointed, but whether he has again regarded the basal joint as double can not be decided either from his figure or from the text. The probability is that he has, for the antennæ in the adults are like those of megalops.

pendages which are entirely wanting in the other two species. These are the temporary mandibular palps, which are attached to the sides of the upper lip, and which serve, up to the first molt, as the second of the two principal locomotor organs. They are made up of two parts, a simple basal portion and a 2-jointed terminal portion bearing at its tip three long plumose setae similar to those on the second antennae in the same species, and, like them, capable of being approximated or separated at pleasure (fig. 5).

The anterior maxillipeds are not modified in any of the larvæ into sucking disks, but retain instead their primitive form of stout clasp-



FIG. 6.—ANTERIOR MAXILLIPED OF NEWLY HATCHED MEGALOPS LARVA SHOWING MUSCULATURE.

organs. They are 4-jointed and furnished at the tip with two strong sickle-shaped hooks, placed side by side, the ventral one of which is armed with three sharp barbs on its inner border. These organs are thus similar to the so-called clasp- ing legs of the parasitic Eucopepods (fig 6).

The posterior maxillipeds are very much smaller than the anterior, and serve as accessory clasp- ing organs, the same function that they perform in the adult. They are 5-jointed in all the larvæ, and are armed on the inner surfaces of each of the four basal joints with spines, stout setae, or rough papillae, the kind, number, and arrangement vary- ing considerably in the different species, but all evidently designed for

the same purpose. These maxillipeds are terminated by two movable, strongly curved claws, and a rounded knob ending in a sharp spine, knob and claws being placed side by side in a line dorso-ventrally, the knob being dorsal. The basal joint is considerably elon-

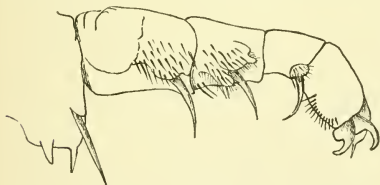


FIG. 7.—POSTERIOR MAXILLIPED OF NEWLY HATCHED MEGALOPS LARVA SHOWING ARMATURE.

gated longitudinally and bears upon its posterior border a short, stout spine (two in *megalops*) in the same place where the spines on the squamiform appendages of the adult subsequently appear (fig. 7).

In *megalops* and *stizostethii* all four pairs of swimming legs are present, and they have the same number of joints and are as fully developed as in the adult. The basipods are 2-jointed, the proximal joints decreasing and the peripheral increasing in length from in front backward. The exopods are 1-jointed and carry two long rowing setae which are plumose and movable like those on the antennae and mandibular palps in the other species. The endopods of the first pair are 3-jointed, the first and second joints carrying sharp spines on their posterior border and the third joint terminating in two similar spines placed side by side. The endopods of the three posterior pairs are 2-jointed and carry but a single rowing seta.

By referring again to fig. 3 it will be seen that these four pairs of fully developed swimming legs can be seen through the egg envelope a day or two before the larvæ emerges.

When it does come forth, therefore, we find it using these same appendages exclusively for locomotion, i. e., *it begins to swim at once in the same manner and by means of the same appendages which it is to use all through life.*

We find in this respect a marked contrast between these two forms, one (*megalops*) from the salt water, and the other (*stizostethii*) from the fresh water, and the three other fresh-water species we are discussing. In the latter only the first pair of legs is at all developed, the other three pairs being very rudimentary, mere stumps in fact, immovable, and hence of no possible use in swimming. These larvæ, therefore, are obliged to depend upon the second antennae and the temporary mandibular palps for locomotion, being aided only slightly, if at all, by the partially developed first pair of legs, i. e., *these larvæ begin to swim in an entirely different manner from the adult, and by means of appendages temporarily developed for that purpose, which afterwards entirely disappear.*

Thus in their development these larvæ show a partial metamorphosis, and stand as a connecting link between the other parasitic copepods (Eucopepods), with their complete metamorphosis through nauplius, metanauplius, and the various cyclops stages, and species like *megalops* and *stizostethii*, in which there is really no metamorphosis at all, at least no change in the number, position, segmentation, or function of the various appendages, but only a few comparatively trifling alterations in size and form.

Both the pointed, retractile proboscis and the mouth parts are present in all the larvæ. The latter take the form of a club-shaped protuberance projecting from the mid line of the ventral surface between the two pairs of maxillipeds.

It is made up of an upper and an under lip and a pair of mandibles, the maxillae not being yet developed. The chewing blades of the mandibles lie just beneath the upper lip, are sickle-shaped and curve in toward each other from either side.

In *foliaceus* and *catostomi* they are armed with a claw on their posterior border which reaches outside the lower lip, and are separated by the side walls of the mouth from the mandibular palps already described. In the *megalops* and *stizostethii* larvæ there are no palps and no claw reaching outside the lower lip, so that the mouth assumes almost exactly the structure of the adult, save for the lack of maxillæ (fig. 8).

With regard to the histology and internal structure, that portion of the intestine immediately behind the mouth and reaching into the first free thoracic segment is somewhat wider than the remainder and is sharply marked off from it by a constriction in the side walls and by much darker coloration. This is the stomach of the larva, and it sends out on either side a wide branch toward the edge of the carapace just

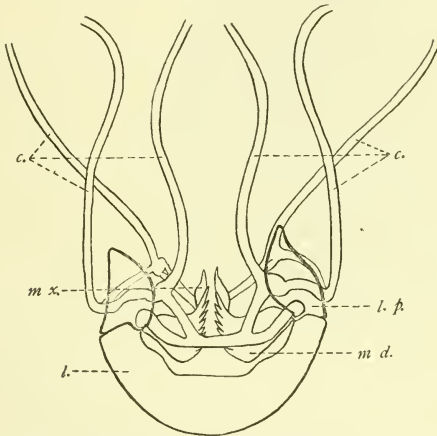


FIG. 8.—CHITIN SKELETON OF THE PROBOSCIS OF A NEWLY HATCHED MEGALOPS LARVA. *c.*, CHITIN FRAMEWORK; *l.*, LOWER LIP; *l. p.*, LABIAL PALP; *m. d.*, MANDIBLE; *m. x.*, MAXILLA.

behind the posterior maxillipeds. (Plate VIII.) The branches turn both backward and forward inside the edge, like a section of the stem and umbrella of a mushroom, and are crenated along their outer border. Both central portion and branches are so filled with yolk granules and oil globules as to be nearly opaque.

The remaining portion of the intestine in the free thoracic segments is somewhat narrower and is filled with much clearer cells. In the last segment it passes abruptly into a narrow cloacal portion which runs through the center of the abdomen as a narrow tube, and ends in the anus, which is a transverse slit situated just beneath the papillæ at the base of the anal sinus. All three parts of this digestive tube keep up a lively contraction, by means of which there is frequent interchange of their contents.

Outside the umbrella portion of the stomach branches, along the lateral and posterior border of the carapace, lies a row of one-celled skin glands with fine awl-shaped ducts leading radially outward to the very edge. These glands are more or less circular in outline and are strongly flattened dorso-ventrally. Their granular contents are arranged in fairly distinct rows radiating from the opening of the duct, which is a little removed from one edge, sometimes near the center.

This gives them somewhat the appearance of miniature palm-leaf fans laid side by side with their handles pointing outward.

In *foliaceus* these side rows are broken by a comparatively wide interval just opposite the base of the mouth, and the two groups thus formed consist, respectively, of 10 posteriorly and 4 anteriorly. There are also in this species a pair of similar glands in front of the first antennæ, a pair at the inner corners of the lateral eyes, a pair behind those eyes, and a group of four just in front of and one behind the lateral branches of the stomach, but there are none in the abdomen.

In the *catostomi* larvæ no glands can be found anywhere in the hundreds of preserved larvæ now at disposal, and in the *stizostethi* larva no mention of them is made, nor do they appear in the figure. In the *americanus* larva the glands are few in number, small in size, and are scattered about promiscuously in both carapace and abdomen, without any regularity. In the *megalops* larva, on the contrary, these glands are much more highly developed, and the largest and best of them lie in a row of six along either side of the abdomen some little distance from the edge (*g.*, fig. 9). In this species the rows along the edges of the carapace are continuous and number 21 or 22 glands each; there is an isolated group of 5 glands between the eyes at the anterior border of the carapace, 3 in front along the edge, and 2 behind them at the interior corners of the eyes. There are also on either side a group of 3 placed diagonally behind the eyes, another group of 2 just in front of the side branch of the stomach, one over the side of the stomach itself where this branch joins it, and a single large elliptical gland at the outer end of the terminal joint of the basipod in each of the swimming legs.

Although these glands are not found in the abdomen of the newly hatched larva of *foliaceus* (Claus) or *catostomi*, they appear there at a later stage in development, and in the adult of all forms which have been examined they are found scattered over the entire surface of the body, being gathered in groups in many places, e. g., in the lobes of the abdomen, the basal joints of the legs, etc. Their function has not been explained by any author, but that they are morphologically simple glands there can be no doubt. Their ducts open at the surface of the body, and under the influence of an alkaline solution a portion of the contents of the body of the gland is discharged through the duct in the form of globules (Leydig). Doubtless they are capable of simi-

lar action under normal conditions, and the more or less metamorphosed contents being thus discharged to the exterior would give them something of an excretory function.

The paired eyes are very large, being made up of many spherical or ellipsoidal facets loosely joined together.

Each eye is inclosed in a transparent blood sinus through which the blood circulates freely by means of three or more openings. The facets jut out quite a distance from the pigment, and along the anterior border of the eye, especially in the *megalops* larvæ, can be seen as transparent yellowish globules. They are proportionately much larger than in the adult.

The unpaired median eye is situated on the top of the posterior border of the brain. It consists of an X-shaped pigment body at the junction of three transparent lobes, shaped and arranged like the parts of a clover leaf. The pigment has a decided reddish tinge.

No heart is visible in any of these larvæ, but its place is supplied by several accessory structures, which produce an active streaming of the blood along practically the same channels as in the adult. The cellular substance between the surfaces of the

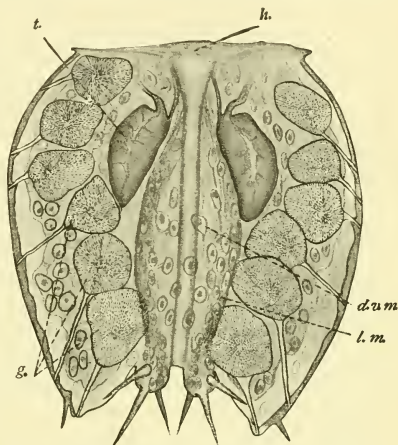


FIG. 9.—ABDOMEN OF NEWLY HATCHED MALE LARVA OF ARGULUS MEGALOPS. *d. v. m.*, DORSO-VENTRAL MUSCLES; *g.*, SKIN GLANDS; *h.*, POSTERIOR WALL OF HEART; *l. m.*, LONGITUDINAL MUSCLES; *t.*, TESTIS.

carapace, in the thorax outside of the stomach and intestine, and in the abdomen outside the sexual organs, is gathered into little islands, between and around which are blood lacunæ in free communication throughout the entire body. There is also quite a wide continuous peripheral sinus around the entire body, particularly in the abdomen. In and out of the lacunæ and through the peripheral sinus the blood is driven by a more or less rhythmical contraction of the following muscles.

In the abdomen between the peripheral glands and rudimentary sexual organs and the central intestine lies, on either side, a spindle of very well-developed longitudinal muscles (*l. m.*, fig. 9).

Scattered irregularly amongst these are short dorso-ventral, individual muscle fibers which are nowhere gathered into bundles (*d. v. m.*).

Most of these latter fibers, as well as those of the longitudinal muscles, are one-celled, and the central nucleus is plainly visible, with one or more long fibrous portions extending from either end. These muscle fibers are strikingly like those elsewhere described¹ in the veliger larvæ of nudibranchs and the pilidium larvæ of nemerteans, and in all probability the fibrous portion is developed in a similar manner by a fibrillar rearrangement of the protoplasm of the original cell. These muscles, both longitudinal and dorso-ventral, contract somewhat rhythmically and drive the blood from the space between them around the cloaca out into the posterior end past the anal papillæ into the peripheral spaces along the sides of the abdomen.

The second muscle to aid in the pulsation takes the form of a transverse dorso-ventral band or curtain lying at the posterior border of the last thoracic segment in just the position occupied later by the posterior wall of the heart (*h.*, fig. 9). This is attached to the side walls of the sinus between thorax and abdomen, but hangs loosely elsewhere, and on contraction produces two movements, one a pulling together of the side walls and the other a backward and forward movement of the center of the curtain. Both motions aid the streaming of the blood. Besides these muscles, which are directly concerned in circulation, there are others in the walls of the stomach and intestine, on the dorsal and ventral walls of the thorax, and even in the basipods of the legs, that must assist the process considerably. The internal tissues are so loosely put together and there is so much free communication between the various parts of the body that a vigorous contraction of any set of muscles, e. g., those in the basipods of the legs during swimming, must produce more or less of a flow of blood in the immediate vicinity.

The skin is so very transparent that even the transverse striation of the muscles can be readily seen through it, so that these larvæ afford one of the best objects for a study of crustacean musculature that could be imagined.

The skin being so thin and the blood circulating everywhere freely beneath it there is no difficulty in bringing about integumental respiration. Such respiration takes place more or less all over the body and does not seem to be exclusively concentrated in any one region. I agree with Claus when, correcting the statements of both Jurine and Dana and Herrick, he says that the abdomen has no more to do with respiration than some other parts of the body and is not as useful in this respect as the side flaps of the carapace. This does not mean that the abdomen does not function physiologically as a respiratory organ; it certainly does and its service is a very valuable one. But it does mean that this is not the only respiratory organ and probably not even the

¹Activities of Mesenchyme in Certain Larvæ, C. B. Wilson, Zool. Bull., II, No. 1, p. 15. The Habits and Early Development of *Cerebratulus lacteus* (Verrill), C. B. Wilson, Quart. Jour. Mic. Sci., new ser., XLIII, p. 97.

best one possessed by the larva. In confirmation of such a view, witness the fact that in several of our largest species (*niger*, *catostomi*, etc.) the abdomen is proportionally very small, in *catostomi* so diminutive compared with the enormous head-thorax that it could not possibly keep the blood aerated.

The nervous system consists of a "brain," which is situated near the dorsal surface of the carapace just above the mouth and just beneath the unpaired eye, and a chain of ventral ganglia (Plate VIII, fig. 24). Of the latter the two anterior ones lie close to the mouth on the ventral surface and the four posterior ones lie beneath the stomach, and are so hidden by its opaque contents as to be visible only during contractions.

On the ventral surface of the brain on either side may be seen a small swelling, the beginning of the mouth commissure, which in later development surrounds the mouth and binds the brain to the anterior ventral ganglion.

Alongside the anterior border of the side branches of the stomach, well out toward the edge of the carapace, may be seen the paired shell glands first detected by Claus in the *foliaceus* larva. As will be seen on Plate VIII, they can be distinguished by the size and grouping of the cells. The walls are two-layered, and at the anterior corners may be seen the lumen of the duct.

In none of the larvæ is there visible anything, even under an oil-immersion lens, which can be definitely asserted to be the beginning of the asymmetrical ovary. And yet there are many reasons for believing with Claus that careful sectioning will reveal the rudiments of an ovary in all these larvæ.

He discovered it just after the first molt considerably developed and reasoned that it must have been present before.

But if this were true in *foliaceus* and *catostomi*, there is, of course, more reason for suspecting it in the much better developed larvæ of *megalops* and *stizostethii*. The probability of its existence is greatly strengthened by the fact that all the other reproductive organs in both sexes are present and plainly visible. The seminal pouches in the female consist of small, inversely pear-shaped bodies placed just inside the row of glands close to the base of the abdomen (*s. p.*, Plate VIII). The ducts from these glands and the papillæ on the ventral surface with which they are connected are not yet developed.

The testes in the abdomen of the male are much larger than these seminal pouches of the female and show the beginnings of a central lumen (*t.*, fig. 9). They correspond in position with the pouches and at their upper ends may be detected the beginnings of the vasa efferentiæ. None of the accessory copulatory organs are present on the legs of the male at this stage.

As soon as they emerge from the egg, therefore, the sex of the larvæ can be determined with certainty.

It is to be regretted that the *megalops* larvæ could not be carried beyond the initial stage, but they had to be kept in salt water, and the supply of salt-water fish and other life was necessarily limited so far inland. Although tried with several possible hosts, nothing could be found that was acceptable, and after living for ten days without any change they finally perished. We have also no record of the *stizostethii* larvæ beyond the first stage, and both must be left for future research.

The *foliaceus* and *catostomi* larvæ agree closely in their development; the first molt takes place about the fifth day and produces a radical change in the appendages (fig. 10). The long rowing branch of the second antennæ and the temporary mandibular palps disappear, the former being replaced by a structure similar to that in the adult, the latter never appearing again.

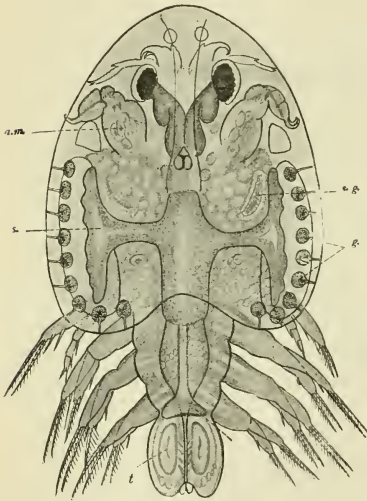


FIG. 10.—LARVA OF ARGULUS FOLIACEUS AFTER THE FIRST MOLT (FROM CLAUS). *a. m.*, ANTERIOR MAXILLIPEDS JUST BEGINNING TO CHANGE INTO SUCKING DISKS; *g.*, SKIN GLANDS; *h.*, HEART; *s.*, STOMACH BRANCHES; *s. g.*, SHELL GLAND; *t.*, TESTIS, SHOWING NOW A CENTRAL LUMEN.

The disappearance of these temporary larval organs of locomotion of course means that the permanent swimming legs have now become sufficiently developed to perform their normal function.

Though not yet like those of the adult in all details, these legs have the same number of joints and approximately the same structure. There has been a corresponding widening of the thorax and abdomen; the posterior border of the latter has become emarginate, and the

very much reduced papillæ are no longer terminal on each lobe, but lie close together in the center of the sinus just above the anus.

The seminal receptacles and testes have enlarged considerably and the former has acquired a thin cellular covering.

The unpaired ovary now appears as a row of small cells along one side or the other of the intestine posterior to the stomach. These cells increase in size, proliferate to the right and left and backward and forward, and their granular contents gradually change with further development.

They also change their position slowly, and finally come to occupy the whole central space beneath the stomach and intestine.

The heart can now be definitely located in the posterior thoracic segment as a triangular pouch with three valvular openings, one median and two lateral, backward into the abdomen, and a large aorta extending forward along the median line to the region of the brain. The two lateral posterior openings discharge blood into the side sinuses of the abdomen during diastole, while the flow of blood backward through the central opening is regulated by the transversely pulsating flap or curtain already described. The aorta pulsates with the heart, but the evidence seems to be in favor of regarding it as an aorta (Claus) rather than as the vestibule of the heart (Leydig), since it corresponds exactly in position and form with the aorta in many copepods, and is also destitute of any side openings.

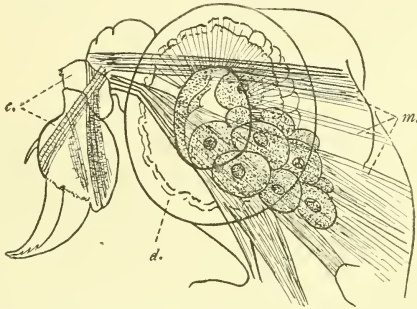


FIG. 11.—ANTERIOR MAXILLIPED OF FOLIACEUS LARVA AFTER SEVERAL MOULTS, SHOWING TRANSITION FROM A CLAW TO A SUCKING DISK (FROM CLAW). *c.*, OLD CLAW BEING GRADUALLY ABSORBED AND ITS MATERIAL USED TO MAKE THE NEW DISK *d.*; *m.*, MUSCLES.

The other changes at this molt are very slight; the first maxillipeds become somewhat thickened through the middle joints, making them spindle-shaped, and along the central axis in between the muscles may be seen a column of large elliptical cells with well-marked nuclei, from which are soon to be developed the sucking disks. These cells are present and distinctly visible in the megalops larva before the first molt.

A second shedding of the skin takes place three or four days after the first, and produces no perceptible changes except in size and in further development of the sucking disks on the first maxillipeds.

The second molt occurs about the tenth day, the third on the thirteenth or fourteenth day, the fourth on the sixteenth day, and the fifth on the twentieth day. During this time the larva gradually increases in size, and the details of structure both external and internal conform more and more to the adult form. This is especially notice-

able in the first maxillipeds where the sucking disks are gradually developed at the expense of the terminal segments and barbed hooks (fig. 11).

The sexual organs have been completed by the development of an oviduct in the female leading back to the sinus between the posterior lobes on the last pair of legs, and by the completion of the vasæ efferentiæ and the formation of ejaculatory ducts in the male. With the fourth molt the copulatory organs begin to show themselves on the legs of the male, and the sucking disks become capable of functioning as organs of attachment. Hence we must regard the larval stage as finished and the fifth period as the beginning of adult life. Subsequent molts follow at intervals of three or four days until, at the end of four weeks, the young Argulids become sexually ripe and the males are capable of the complicated process of copulation. They are now from 2.5 mm. to 3 mm. in length, and Claus states that in *A. foliaceus* the females must reach a length of at least 7 mm. before becoming ready for their first egg laying.

SUMMARY.

1. The female Arguli do not carry their eggs about with them, but deposit them in rows upon stones or other convenient hard surfaces and leave them to care for themselves.

2. The eggs are ellipsoidal in form, 0.35 to 0.45 mm. in length, and are placed end to end in the rows. They are covered with a gelatinous envelope, which swells and hardens on contact with water, fastening the eggs securely to the surface and to one another.

3. In the period of incubation the Arguli separate into three groups, one of which, represented by the two fresh-water forms, *foliaceus* and *catostomi*, requires thirty to thirty-five days before hatching. A second group, represented by the fresh-water form *americanus*, requires but fifteen to eighteen days, while the third group, represented by the fresh-water *stizostethii* and the salt-water *megalops*, remain in the egg from sixty to eighty days.

4. The emerging larvæ separate themselves into two groups corresponding, respectively, to the three short and the two long periods of incubation.

In the group which hatches in a month or less the nauplius, metanauplius, and early cyclops stages are passed inside the egg and the larva emerges in a later cyclops stage with all the appendages present, but many of them in a very rudimentary stage of development. Locomotion is effected by means of the second antennæ and a temporary pair of mandibular palps, both of which are elongated and tipped with long rowing setæ. Only the first pair of legs is at all developed, the others being mere immovable stumps. The first maxillipeds are not modified into sucking disks, but terminate in stout barbed hooks.

Reproductive organs are present and so far developed that the sex of the larva can be told at birth.

5. In the second group, which requires two months or over for incubation, the development of the larva inside the egg is carried still farther, so that it emerges not merely with all its appendages present, but with each fully developed, except the anterior maxillipeds, and all (even these) performing their appropriate functions. The swimming legs are sufficiently developed to be used exclusively for locomotion; the second antennæ are similar to those of the adult, and there are no temporary mandibular palps. The first maxillipeds and the rudimentary sexual organs are similar to those in the other group.

In these larvæ, therefore, there is no real metamorphosis after birth, since nothing but the first maxillipeds are at all changed in structure and even these serve the same function from the first.

6. By a series of molts at intervals of a few days the larva is gradually transformed into the adult. At the fourth molt, sixteen days after hatching, the sucking disks are so fully developed as to begin to function, and the sexual organs have matured, so that this molt is to be regarded as the close of the larval period.

MORPHOLOGY.

Body regions.—In consequence of the peculiar relations existing between the parts of the body in the Argulidæ we find different authors assigning entirely different names to them. This has been due in large measure to those modifications of the paired appendages resultant upon the parasitic habits of the animals, e. g., the hooks upon the anterior antennæ, the sucking disks upon the anterior maxillipeds, etc.

These modifications caused numerous mistakes in the early interpretations of the appendages, with corresponding mistakes in the body regions to which they are attached.

To Thorell (1864) and Claus (1875) more, perhaps, than to any other investigators are we indebted for the elimination of these errors, the scientific comparison of this group with others closely related to it, and its final establishment in its present position.

But both these authors worked with a very limited number of species. Claus's observations were confined to the two fresh-water species *foliaceus* and *coregoni*, and Thorell only added one other form, *purpureus*, which, however, was a parasite on salt-water fish. In view of such a meager supply of species upon which to base family characteristics, and the consequent doubt as to how fully they might have represented the entire family, it is hoped that the following comparative study of 13 American species, together with the comparative ontogeny which has preceded, may serve to supplement the data already given, and so strengthen Claus's assignment of the group.

The body of an Argulid divides itself naturally into three regions—

a cephalo-thorax, a free thorax, and an abdomen—the first and third being unsegmented, while the free thorax is divided into three well-defined segments. These regions thus correspond closely to those in the Eucepods. The anterior one has always been called the cephalo-thorax, but there has been considerable question as to how many segments of the thorax were fused with the head.

The answer to this question, and with it the solution of the whole problem of the body regions, the other two of which have received all the different names possible, rests entirely upon our interpretation of the two pairs of appendages which, in common with Claus and Thorell, we have designated as the anterior and posterior maxillipeds, but which are really the endopodite and exopodite of the posterior maxillæ, separated, and each joined to the body by an independent basipodite. If this latter statement be true, then of necessity only a single segment of the thorax is fused with the head. The free segments following must be the remainder of the thorax, and the unsegmented posterior portion is the abdomen. The only other supposition possible is that the appendages in question are anterior thoracic legs, which has been earnestly advocated by several authors.

If we can decide between these two alternatives, all the other problems will solve themselves.

First, then, the evidence in favor of regarding these appendages as anterior thoracic legs rests entirely upon their present form and function. But the value of such evidence must disappear the moment we reflect that these animals are parasites, for we have every reason to believe that both the form and the function of many appendages would of necessity be radically changed by long-continued parasitic habits.

In proof of this, witness the present form and function of the antennæ and mouth parts. Why may there not have been a similar change in the posterior maxillæ?

Again, the first pair of these appendages is placed so far forward that, if they are really thoracic legs, the mouth parts are entirely out of place for a crustacean, and particularly for one so closely related to the copepods.

Furthermore, if we are to look upon them as grasping or walking legs, it is evident that the appendages intervening between them and the mouth (i. e., the posterior maxillæ and the maxillipeds) have been suppressed, and that, too, so thoroughly that not a trace of them is left, even in early development.

But the appendages which do remain are perfectly developed, and such a complete suppression without assignable cause demands far better proof than mere present form and function.

The best argument, however, is derived from analogy. These two pairs of appendages correspond almost exactly in form, position, and

function with those called similarly maxillipeds in the Caligidæ. And since the habits of the two groups are alike we may reasonably assume that these similar appendages would correspond in origin and morphological significance.

But Claus has already proved that the so-called maxillipeds in at least a part of the Caligidæ (all the species in which he could prove anything) are the endopodite and exopodite, respectively, of the posterior maxillæ. Such being the case, we are compelled to regard these maxillipeds as similar in origin until definite proof can be obtained from their early development.

The three regions in an Argulid's body, therefore, are as we have already named them, a *cephalo-thorax*, in which only the anterior segment of the thorax is united with the head, a *free thorax* of three well-defined segments, and an *abdomen*, unsegmented and without appendages. The old name, "tail," has persistently clung to this posterior region, in spite of the fact that it contains the cloacal portion of the intestine, together with the testes in the male and the seminal pouches in the female.

The cephalothorax is much larger than both the other regions, and is developed into a broad horseshoe-shaped shield or carapace. This shield is strongly flattened dorsoventrally, but remains convex dorsally and concave ventrally like that of the horseshoe crab. Its sides (except in *A. elongatus*) are produced posteriorly into two broad, well-rounded lobes, in whose size and posterior reach we may find all gradations from those which barely cover the bases of the second pair of legs (*megalops. funduli, latus*) to others which reach back over the entire thorax and abdomen (*purpureus*), so that the carapace is the only thing visible in a dorsal view (see figs. 2, 12 (text), 24, 65).

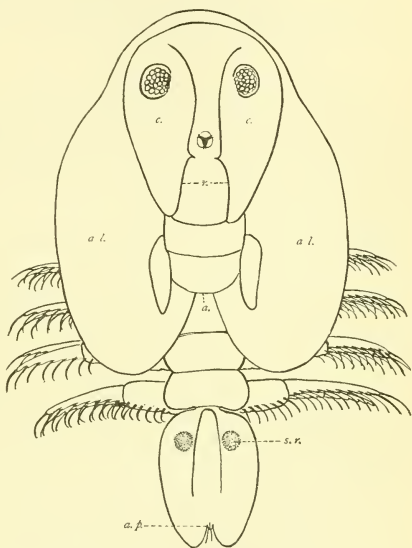


FIG. 12.—DORSAL VIEW OF ADULT ARGULUS MEGALOPS FEMALE. *a.*, JUNCTION OF CEPHALO—AND FREE THORAX; *a. l.*, ALE OR WINGS OF CARAPACE; *a. p.*, ANAL PAPILLE; *c.*, CEPHALIC AREA OF CARAPACE; *r.*, LONGITUDINAL CHITIN RODS; *s. r.*, SEMEN RECEPTACLES.

But however far back the lobes may extend, the sinus between them is always cut forward to the posterior border of the first thoracic segment, the one fused with the head. The base of this sinus, therefore, marks the division line between the cephalo and the free thorax (*a.*, fig. 12). The inner borders of the lobes are usually some distance apart, the sinus having a broad, more or less squarely truncated base. But sometimes it is so narrow that the lobes approach each other closely, and in alcoholic specimens may even overlap (*niger*, *aloxæ*, *americanus*).

These inner lobe borders may be parallel (*foliaceus*, *maculosus*) or may even converge posteriorly (*niger*, *catostomi*, *americanus*), but they usually diverge somewhat sharply, carrying the tips of the lobes away from the body (*megalops*, *laticauda*, etc.).

In its general shape or outline three types of carapace may be recognized, the *orbicular*, in which the width equals or exceeds the length (*catostomi*, *latus*, etc.), the *elliptical*, in which the length is considerably greater than the width (*foliaceus*, *laticauda*, *megalops*, etc.), and the *obcordate*, in which the greatest width of the carapace is nearer the posterior end (*americanus*, *purpureus*, etc.). It is a fact worthy of note here by reason of its important bearing upon the physiological function of the abdomen that species having a carapace of the first type have comparatively small abdomens, and in general the larger the carapace lobes the more restricted the abdomen.

In addition to the posterior sinus there is a broad, shallow lateral sinus on either side opposite the eyes.

At the base of this sinus a V-shaped portion of the carapace is quite clearly differentiated from surrounding portions by its greater thinness and perfect transparency (fig. 24). Both these differences are due to the fact that here the dorsal and ventral surfaces of the carapace approach each other until they come in actual contact and fuse together. From the points of the V's a narrow groove extends backward and inward on either side in a horseshoe-shaped curve, the toe of the shoe crossing the median line about where the anterior edge of the first or fused thoracic segment would naturally come (figs. 12 (text), 2, 6, etc.).

This groove divides the carapace into three regions—the cephalic or anterior oval region and the right and left lateral regions or *alæ* (*c.* and *al.*, fig. 12). Each region is capable of more or less independent motion, bending along the groove.

The cephalic region varies greatly in shape with the varying shape of the shield, being comparatively short and wide in those species which have an orbicular shield, while it is long and narrow in those whose shield is elongated.

Through its center longitudinally run two ribs formed by a thickening of the cuticular chitin (*r.*, fig. 12). These ribs start from the toe of the horseshoe and run forward toward the anterior margin. They first diverge slightly in a broad curve until they have passed the brain

and then curve inward toward each other, sometimes almost meeting at the median line, and finally diverge again toward the bases of the anterior antennæ.

Each one thus takes somewhat the shape of the old-fashioned letter *f*, the two letters being placed back to back. In *foliaceus* the anterior end of these ribs appears branched (Claus) as also in *salmi* (Kröyer), but this occurs in none of the North American species examined.

These long ribs are jointed once just behind the brain, to give the anterior region of the head greater freedom of motion.

They are also connected with each other, posterior to the joints, by several cross ribs, the first of which is close to the joints and quite concave toward the brain.

In some species (*niger*, *foliaceus*, *funduli*) these cross ribs give the appearance of vertebrae, especially in alcoholic specimens, as noted by Claus, but they are practically invisible in the living animal by reason of their transparency, as can be seen in the photographs. Other stout branch ribs extend radially outward from the mid-line toward the lateral margin, the largest and most conspicuous pair being situated between the posterior maxillipeds and the anterior swimming legs (figs. 14, etc.).

In addition to these ribs there are two oval chitinous rings in each lateral ala at some little distance from the margin.

The anterior one is short, often triangular, and situated about opposite the mouth, while the other is much larger and longer and reaches nearly the entire length of the lateral area.

The shape and arrangement of these lateral rings is peculiar for each species and affords a very reliable secondary specific character, as will be readily seen by comparing any two of the figures showing the ventral surface.

The free thorax has a flattened conical form, the segments diminishing in size from in front backward. The posterior segment is triangular in outline, the apex of the triangle terminating posteriorly on the ventral surface at the opening of the oviduct or the vas deferens. On the dorsal surface this posterior segment is usually more or less overlapped by the abdomen. Each segment, including the one fused with the head, carries a pair of swimming legs, the posterior pair pointing obliquely backward in consequence of the oblique sides of the segment which carries them. In alcoholic specimens these posterior legs are often curled in and wholly covered by the abdomen. (See figure of *A. niger*.) The thorax has no other appendages save in *purpureus*, where there are two scale-like lobes attached to the posterior segment on the ventral surface and projecting backward beneath the abdomen (fig. 65).

The latter is much thinner than either of the other two body regions. It consists of little more than two plate-like lobes or lamellæ, filled

with blood sinuses and carrying in their thickened bases the testes in the male and the seminal receptacles in the female. Through the center runs the much-narrowed cloacal portion of the intestine and around this are longitudinal muscles which assist in circulation (p. 669).

The outline of the abdomen is usually oval or broadly triangular. In some species whose cephalothorax is orbicular the abdomen also approaches closely to that shape (*catostomi*). In other species (*lati-cauda*, etc.) it is broadened posteriorly until it becomes almost perfectly elliptical. Its size and shape differ greatly in the two sexes even of the same species. The presence of the long testes elongates the lobes until sometimes the abdomen of the male is nearly twice as long as that of the female (*funduli*).

It is always much longer, and thus produces a narrowed elliptical form, with a tendency toward acumination in the lobes posteriorly. On the other hand, the spherical seminal receptacles of the female are situated far forward in the lobes and tend to widen that portion especially, producing a broad triangular form, usually with blunt, rounded tips.

The abdomen is cut posteriorly by a median sinus which runs forward between the lobes very varying distances in the different species. It may be broad, shallow, and well rounded (*catostomi*), broadly triangular (*maculosus*, *lepidostei*), narrowly triangular and cut deeply (*stizostethii*, *niger*), or so narrow as to be slit-like (*versicolor*).

The anus is situated at the base of the sinus, and somewhere along the sides or at the base are to be found the anal papillæ.

The position of these papillæ as subterminal, lateral, or basal adds another secondary specific character which is very useful in classification.

The appendages.—On the ventral surface of the carapace we find the cephalic and the first thoracic paired appendages, and along the median line the sting and the mouth apparatus.

The two pairs of antennæ are situated in front of the eyes and lie in shallow troughs or depressions in the ventral surface of the carapace. The first antennæ have a broad flat basal portion which is two-jointed; the proximal joint is much the smaller of the two, triangular in shape, and is prolonged backward into a stout blunt chitinous spine.

The distal joint is considerably elongated at right angles to the proximal one (and hence at right angles to the central axis), and it terminates in a strong sickle-shaped hook which is curved over ventrally. There is usually a similar but much smaller hook upon the anterior margin near the base of the joint, and in most species a stout spine, occasionally two of them (*versicolor*), upon the posterior margin.

The terminal portion of the antenna which is three-jointed is so diminished in size and relatively so insignificant as to be easily overlooked. Furthermore, it is fastened to the distal joint alongside the

huge chitinous hook and in some species (*laticauda*) does not reach beyond the latter.

The larval development shows that this prehension which so predominates in the adult is really acquired and that the antennæ are originally tactile.

The second antennæ have retained this original function in greater measure than the first. They consist of a stout cylindrical basal portion, which is also produced backward near the median line into a blunt chitin spine similar to that on the first antennæ and right in line behind it.

Sometimes this spine is reenforced by another situated just anterior to it, the two and the spine on the proximal basal joint of the first antenna forming a row alongside the median line (*maculosus*, *americanus*). The remaining three joints of these second antennæ are much narrower than the basal one and the terminal joint is also very short. They are all, including the basal joint, armed with a few bristles on their anterior surfaces at the distal ends. The three terminal joints are usually flexed posteriorly until they form a right angle with the basal joint.

The anterior maxillipeds in all adult Arguli are modified into sucking disks. This also, as can be seen from the ontogeny, is a derived or acquired character.

The function of prehension is of course the same whether the appendage end in a claw or a sucking disk, but with the growth of the disk comes a secondary function of walking or scuttling about over the surface of the fish's body. For this the disk is much better suited than a terminal claw; the latter gives as firm a hold when once fixed in the fish's skin, but does not admit of adjustment rapid enough to be used as an organ of locomotion. These disks consist of a short cylindrical basal portion, representing the basal joint of the original larval appendage, and a terminal border of nearly twice the diameter.

The latter does not represent the terminal joints of the original appendage, but seems to be a new growth after the absorption of those joints. In the larval development these joints persist for a long time as a useless appendage attached to the side of the maxilliped between the base and the border, and they seem to be gradually absorbed and used in making the border, much as the tadpole's tail is used to make the hind legs of the little frog. The border is largely membraneous, is serrated around the edge, and is strengthened by numerous rays which

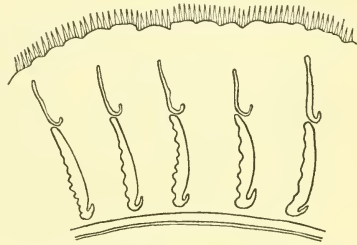


FIG. 13.—BORDER OF SUCKING DISK IN ARGULUS AMERICANUS.

are formed in a very different manner in the various species. In *foliaceus* they consist of a row of chitin joints so short as to appear spherical or slightly elliptical (Claus). In *americanus* they consist of two concentric rows of chitin rods, each of which is shaped like the letter J (fig. 13).

The rods in the outer row are much smaller than those in the inner one, and they do not reach nearly to the edge of the membrane. In *megalops* the rays are made up of a series of trough or gutter shaped plates overlapping one another like shingles (fig. 14).

The base of the membrane is strengthened by three chitin rings, the basal one of which is large enough to hold its shape perfectly against the contraction of the muscles.

The terminal one serves as a support for the rays and to it their proximal ends are attached. This border contains two sets of muscles, circular and radial, by which it can be elevated till it assumes the same direction as the cylindrical base and simply forms a hollow terminal portion to the latter, or it can be depressed till it stands out at right angles to the base like the

brim of a hat. It often assumes the first position on fixation, but the last one is the normal posture in the living animal. Its membranous structure, strengthened by the chitin rays, with the flexibility produced by the joints in the latter, and the serrated edge, enable it to fit down snugly to the rough surface of the fish's body



FIG. 14.—BORDER OF SUCKING DISK IN ARGULUS MEGALOPS.

and produce a tight joint. The lumen of the base is nearly filled by four large muscles arranged in pairs, approximately right and left and anterior and posterior. By the contraction of these muscles a partial vacuum is formed inside the base and the flexible border is securely fastened to the surface on which it rests. The simple relaxation of the muscles restores the original lumen and the disk is detached.

By relaxing its hold with one disk and carrying it forward while the other remains fastened the animal moves about with surprising rapidity. Not only is Thorell wrong when he says (1864) that these appendages are "used exclusively as fixing organs," but it seems highly probable that they have been modified into this disk form for the express purpose of functioning as locomotor organs. And while the function of fixation may, and probably does, still take precedence, yet that of locomotion becomes a close second. The relative size of these disks varies greatly; in some species (*funduli, latus*) it reaches nearly a third the width of the carapace, and be it remembered these are forms in which the carapace is orbicular. In others (*laticauda, megalops*) it is not more than a sixth or a seventh of that width.

The second maxillipeds retain more of their original shape. They consist of a short basal segment and four longer terminal ones. The ventral surface of all these segments, over the whole or a part of its area, is raised up into rough papillæ, or armed with spines and bristles pointing backward.

In addition the basal segment has on its ventral surface a raised area, often armed with spines or bristles. This area projects posteriorly beyond the border of the joint, and in all species examined except one (*latus*) is produced into three strong teeth. For this reason it was designated by Kröyer as the "kammen" (pecten or comb). In many species (*lepidostei*, etc.) these teeth are long and very sharp, while in others they take on more of the nature of plates, being broad and squarely truncated or only a trifle rounded posteriorly (*laticaula*, *catostomi*). The terminal segments of these appendages are armed with two claws and a third process or papilla, often ending in a spine. (Plates X, XII, XXI.)

With reference to the use of these appendages, it is at once evident from the spines, teeth, and rough areas on their ventral surfaces that they serve to keep the Argulus from slipping backward on its host, and that this must be their chief function.

Such an interpretation is strengthened by the fact that in those species which have the spines and hooks of the antennæ and the ventral surface of the carapace particularly well developed (*maculosus*, *americanus*, etc.) the posterior maxillipeds are comparatively small and poorly armed.

On the contrary, species like *catostomi* and *alosse*, where the spines on the antennæ are weak and insignificant, the posterior maxillipeds are large, stout, and well armed. There is thus in every species examined quite a uniform balance between the size and armature of these posterior maxillipeds and that of the antennæ and carapace.

That these appendages may also be used for "cleaning the sucking cups and for removing extraneous particles from the cavity," as maintained by Vogt (1845), seems very likely from the forceps nature of the claws on the terminal joint, but the present author has never had the good fortune to actually witness such an operation. That they "serve principally as organs of locomotion and may therefore be called creeping feet (*pedes gessorii*), as they have, indeed, been named by Kröyer" (Thorell), does not seem probable either from their structure or their development. And in the scores of living Arguli which have been carefully watched no such use of these appendages has ever been detected.

The four pairs of thoracic appendages are swimming feet and are the principal organs of locomotion. They each consist of a two-jointed basipod and an exopod and endopod, of which the former is slightly the longer. The joints of the basipods on the several pairs of legs

show a regular gradation in length, the proximal ones diminishing and the distal ones increasing, from in front backward. The proximal joints of the posterior pair of legs are usually triangular in shape to fit the sides of the triangular posterior thoracic segment.

They are also produced posteriorly into lobes more or less boot-shaped, with the toes turned outward. In some species (*maculosus*, *versicolor*, *lepidostei*), these lobes are as large as or even larger than the joints themselves.

In the female all the other basipod joints (except the posterior) are simple and without appendages, but in the male the two posterior pairs of legs in all species, and in some the three posterior pairs, carry accessory sexual organs upon their basipods. These will be described more fully later. The endopodites of the first pair of legs are three-jointed, the basal joint including the larger part, while the two terminal joints are very small and short. The latter do not carry setae like the basal joint, and they terminate in a pair of forceps-like spines.

The endopods of the second pair of legs are not jointed; those of the third and fourth pairs are jointed once near their center. The exopods in all four pairs of legs are *without joints*. Kröyer, Vogt, and Leydig were deceived by the swollen bases of the large rowing setae into declaring that both exopods and endopods were many jointed, and this error has been religiously preserved down to the very latest text-books.

Lang distinctly says that the exopods and endopods in the Argulidae "are long and many jointed."¹ Parker and Haswell do not make any statement, but Claus's figure, which they publish, shows many joints.

This figure was drawn by Claus to show the development of the testes and the sucking disks on the anterior maxillipeds, and he has slurred over many of the other details. That he did not intend to represent the endopods and exopods as actually jointed is abundantly manifest from enlarged detailed drawings of the three posterior legs of the male (the figure in question is also that of a young male), in which they are represented correctly as without joints, save for the single middle joint in the endopod of the two posterior legs. Furthermore, he distinctly says, in the text accompanying these figures,² that "in the place of numerous joints capable of independent motion, there are only joint-like breaks or intervals apparent in the hair-like foot branches."

This is certainly the condition in every American species examined, as is readily proved by reference to the musculature.

In all the exopods and in the two anterior endopods there is a single unbroken muscle strand running from base to tip. In the two posterior endopods this strand is broken at the central joint, as are the muscles everywhere else at joints in all the appendages (fig. 15). It is

¹Part I, p. 316, English translation.

²Edition of 1875, figs. 44, 45, and text, p. 250.

unfortunate that Claus's figure should have become the classic for all text-books, encyclopedias, and dictionaries. It does not show any of the segmentation in the swimming legs correctly, and without the accompanying text manifestly places its author in error.

Both exopods and endopods are furnished with two rows of long plumose setæ along the dorsal and ventral edges of their posterior surface, which render them efficient oars for propulsion through the water. Similar shorter setæ are found along the posterior border of both basipod joints of the posterior legs, and in some species (*maculosus*, *versicolor*, etc.) along the basipods of all the legs. Often, also, the entire surface of the boot-shaped appendages of the basal joints of the posterior legs will be found covered with these setæ.

More than half the species (17 out of 26) have an appendage called a flagellum (*Geißelanhang*) attached to the two anterior pairs of legs. This consists of a slender shaft attached to the distal end of the basi-

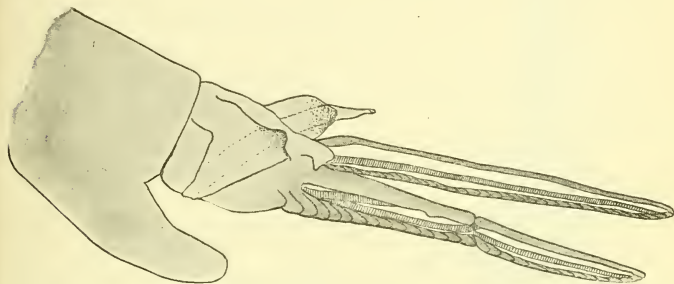


FIG. 15.—POSTERIOR SWIMMING LEG OF ARGULUS AMERICANUS; THE ARRANGEMENT OF THE MUSCLES SHOWS CONCLUSIVELY THAT THE EXOPODITE IS NOT JOINTED, AND THAT THE ENDOPODITE HAS BUT A SINGLE JOINT.

pod, just above the base of the endopod. At first it is directed outward parallel to the endopod, but is bent abruptly upward and inward, so that it lies along the dorsal surface of the basipod.

It also carries two rows of plumose setæ and is capable of independent motion. There can be little doubt that one at least of its functions is to keep the ventral surface of the carapace clean and to remove any foreign particles that might find lodgment between the legs and carapace. The blood enters the main shaft of these flagella just as it does the exopods and endopods of the swimming legs, but can not of course get out into the setæ. This coupled with its very small size renders it difficult to see how such an appendage can serve any important respiratory function.

In the females of many species we find a pair of long finger-like papillæ, situated one on either side of the opening of the oviduct between the bases of the posterior pair of legs.

These are manifestly tactile organs and assist in placing the eggs during egg laying. They are never found on males.

The abdomen has no appendages nor any trace of them at any stage in its development.

The digestive system.—The mouth parts consist of two separate organs united at their bases. The anterior portion has been called, respectively, a “sting,” a “gadd,” and a “sucker” by various authors. The first of these names is the most applicable. This sting is a long,

very sharp-pointed spine, tipped with chitin and inclosed in a sheath of the same material, to which it is so attached that it can be extended and withdrawn like the finger of a glove. When not in use, it is partly withdrawn and lies in a longitudinal groove which runs forward between the bases of the antennæ. It is a veritable sting, for the spine is hollow and its lumen serves as the duct of a poison gland situated at the base of the sheath.

The inner portion of the sting is soft and flexible and is folded upon itself when withdrawn. It is forked near the base of the sheath and a branch of the duct passes out to the poison gland on either side (fig. 16).

When wished for use, the sting is dropped down from its groove upon the fish's skin, into which it is then pushed by eversion.

Thus in the way in which it is carried and used the sting bears considerable resemblance to the proboscis in certain hemiptera. Its chief use appears to be that of puncturing the skin and securing a strong flow of

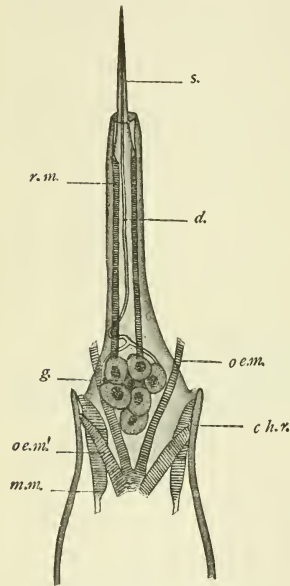


FIG. 16.—STING AND POISON GLAND OF ARGULUS VERSICOLOR. *ch. r.*, CHITIN RIB OF PROBOSCIS; *g.*, POISON GLAND; *d.*, DUCT OF POISON GLAND; *m.m.*, MANDIBLE MUSCLES; *oc. m.*, OESOPHAGUS MUSCLE; *oc. m'*, SIDE MUSCLE OF OESOPHAGUS; *r. m.*, RETRACTOR MUSCLE; *s.*, STING.

blood both by its wound and also the irritation caused by the pouring in of the secretion from the gland.

The posterior portion of the mouth apparatus is the proboscis; it also is cylindrical and can be elevated or depressed at pleasure. But it is much larger in diameter than the sting and is somewhat club-shaped at the free end. When not in use, there is a groove extending back between the bases of the two pairs of maxillipeds in which it is carried.

The walls of the proboscis are formed of an upper and an under lip, respectively, which are held in place and at the same time rendered flexible by a jointed chitin framework.

The latter can be seen on either side of the proboscis tube as a series of longitudinal ribs, forked at their distal ends, where they are united to one another and to a transverse framework which bounds the oral aperture and gives support to the mandibles and maxillæ. The pattern of this framework, as well as the details of the mandibles and maxillæ, varies greatly in different species, but the essential features are the same in all, and are as follows:

The under lip forms the posterior surface of the tube and spreads down over the hood-shaped end and up a very little way on the anterior side, terminating in the shape of a half-moon around the lower border of the mouth aperture (fig. 17).

At either side this half-moon is prolonged into a triangular flap which projects upward over the outer surface of the upper lip, and must hence be regarded as a rudimentary labial palp (*l. p.*).

The remainder of the ventral surface is formed by the upper lip, which terminates at the mouth in a somewhat squarely truncated (*americanus*, *catostomi*) or even emarginate (*niger*, *megalops*) lip proper, projecting into the concavity of the under lip.

In *foliaceus*, in addition to the transverse opening at the end of the proboscis, there is a narrow, somewhat lance-shaped longitudinal slit extending along the anterior surface toward the base of the proboscis. This slit is considerably longer than the transverse opening, and its edges are sharply serrated where it merges into the latter.

Hence the mouth opening has an elongated triangular form in *foliaceus*. But in *catostomi* the longitudinal slit is very much shorter than

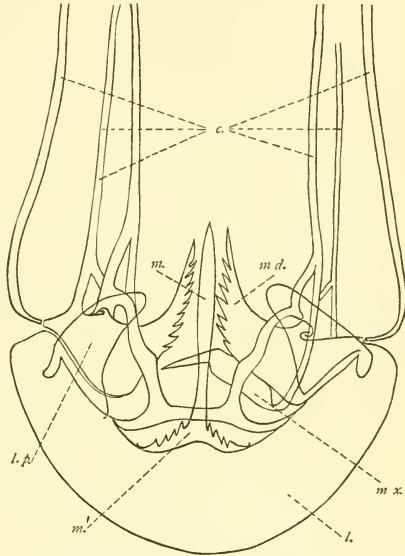


FIG. 17.—MOUTH-PARTS AND CHITIN SKELETON OF PROBOSCIS OF ARGULUS FOLIACEUS (AFTER CLAUS). *c.*, CHITIN FRAMEWORK; *l.*, LOWER LIP; *l. p.*, LABIAL PALP; *m.* AND *m'*, LONGITUDINAL AND TRANSVERSE PORTIONS OF THE MOUTH OPENING; *m d.*, MANDIBLE; *m. x.*, MAXILLA. (COMPARE WITH FIG. 8.)

the transverse one, in fact is little more than a notch in the upper lip, though its edges are still serrated like those of *foliaceus*. In many of the other species (*niger*, *megalops*, etc.) the longitudinal slit disappears entirely, leaving a curved mouth opening transverse to the long diameter of the proboscis tube and often slightly enlarged at either end. In these forms also there is no serration of the edges of the mouth opening. Just behind the labial palps on either side the chitin framework is thickened somewhat where the longitudinal ribs join the transverse rods, and to these thickened joints are attached the mandibles and maxilla.

The mandibles (*md.*) are elongated, somewhat triangular or broadly sickle-shaped chitin plates, which curve inward and upward toward each other so that their pointed and toothed tips almost meet in the mid line of the gullet above the mouth opening.

They are always bordered by sharp-cutting teeth on their inner margins, and sometimes (*americanus*, etc.) along the outer margins also, and are evidently designed to cut and tear the flesh of the parasite's host and so stimulate the flow of blood. The two maxilla (*mx.*), for there is but a single pair, are also thin chitinous plates of various shapes, which are attached at the same place as the mandibles, but which extend backward and outward behind the mandibles nearly parallel with each other. They are sometimes toothed on their inner margins (Thorell), but are usually smooth and terminate in a long sharp spine, which also is evidently used to stimulate the flow of blood from the host.

The proximal end of the proboscis passes directly into the short œsophagus, which in turn opens into the stomach.

These portions of the digestive system are the same in the adult as in the larva and do not need to be described again here.

The only thing to be added is that the side pouches of the stomach become more and more branched with age until finally they are entirely broken up into ramifications, as is well shown in the photograph of *americanus* (fig. 84).

The circulatory system.—There is a well-defined heart and a short aorta which opens directly into the body cavity, but there are no other blood vessels of any sort. Instead, the blood circulates about freely through the lacunæ and sinuses, which form a network all over the body, as already described (p. 669).

The blood itself is a colorless liquid in which float numerous corpuscles. The latter are smooth, spindle, or pear-shaped, and occasionally somewhat fibrous at the ends.

As soon as the circulation stops they sink to the bottom, but they do not become spherical in any American species so long as the animal remains alive. They contain a well-defined nucleus, which can be brought out clearly by the addition of a little acetic acid (Leydig).

The heart lies in the median line of the body, just beneath the skin of the dorsal surface. It is triangular in outline, the base of the triangle extending squarely across the thorax at its junction with the abdomen. The apex of the triangle passes directly into a long cylindrical aorta, which reaches forward, diminishing gradually in size, to the brain, under which it opens into the cœlom. The walls of both heart and aorta are well supplied with striated muscle fibers by whose contraction a rhythmic pulsation is produced.

Jurine (1806), Leydig (1850), and Claus (1875), have each described in some detail the course of the blood currents in *foliaceus*, and the present author has observed them in the three American species, *versicolor*, *americanus*, and *catostomi*.

Of these species the course of the blood in *versicolor* and *catostomi* corresponds quite closely with that given for *foliaceus*, but in *americanus* it is quite different in several details.

In the former species the heart has six openings; of these two are median and four are paired at the sides (Claus, fig. 37).

One of the median openings is anterior and passes into and through the aorta and out into the cœlom under the brain. The other is posterior and opens backward through the ventral part of the base of the triangle into the sinus around the cloaca.

Of the paired openings the anterior pair are ventral and consist of a diagonal slit on either side just at the base of the aorta. The posterior pair are lateral and open out of the basal angles of the triangle into the broad sinus which follows the edge of the abdomen. These lateral paired openings and the posterior median opening are guarded by valves, but the other three open and close by the simple approximation and separation of the edges of the slits.

The heart pulsates about once a second and drives the blood out through the aorta. This stream almost immediately divides, portions going to the right and left and bathing the tissues of the head and antennæ, and especially the eyes, which are entirely surrounded by a wide sinus. Another portion turns downward into the common base of the proboscis and sting and there separates, a part going forward into the sheath which surrounds the sting and a part backward into the proboscis.

All these anterior streams turn back on either side to the bases of the anterior maxillipeds. A part enters the maxillipeds themselves, a part keeps on posteriorly, passing the bases of the swimming legs and sending out currents to each, and the remainder turns out sidewise into the lateral areas of the carapace. Here it percolates through the lacunæ, between and around the numerous stomach ramifications, gradually working its way back in broad curves to the two central side streams, which finally enter the heart by the ventral unguarded slits.

At every pulsation also a portion of the blood is driven backward through the posterior median opening into the sinus around the cloaca. The bulk of this stream passes directly back to the anus where it divides, a half passing around the wide sinus on the border of each lobe of the abdomen.

But portions of the central cloacal stream are given off sidewise all the way back to the anus: these percolate through the sinuses and lacunæ and around the sexual organs of either lobe and finally join the returning streams along either margin and enter the heart through the posterior valved lateral openings.

In this way a constant interchange of the blood from various parts of the body is maintained, and that portion of it which percolates through the lateral areas of the carapace and the lobes of the abdomen is thoroughly purified during its passage.

The circulation in *americanus* differs in several particulars; there are but five openings in the heart, the ventral one consisting of a single median longitudinal slit instead of paired lateral ones (fig. 18). All the blood enters through the lateral valved openings *a*; a part of it passes out of the aorta anteriorly *b* and another part out of the posterior median aperture *d*, and each of these streams follows the same course as in *foliaceus*. But the greater bulk turns downward and passes out of the median ventral slit (*c*). This stream pours around the intestine and separates naturally into two side streams, running forward past the bases of the swimming legs, sending

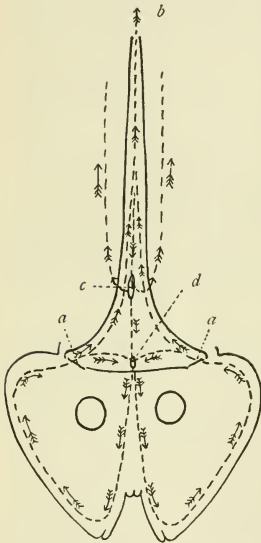


FIG. 18.—DORSAL VIEW OF THE HEART OF *ARGULUS AMERICANUS* (DIAGRAMMATIC). *a*, PAIRED LATERAL OPENINGS; *b*, ANTERIOR OPENING OF AORTA; *c*, ANTERIOR, AND *d*, POSTERIOR VENTRAL OPENING.

out lateral streams into each of them, and joining the anterior streams from the aorta underneath the brain. On its return the blood percolates through the lateral sinuses of the carapace and, joining the streams from the borders of the abdomen, enters the openings at the sides of the triangular base of the heart. (See also fig. 19.)

This circulation does not depend for its impetus upon the pulsation of the heart alone. It is helped, as such lacunal circulation must always be, by the contraction of muscles in various parts of the body. Especially is this true of those muscles which contract somewhat rhythmically, like the muscles of the stomach and intestine in their peristaltic movements, and of the legs in swimming. There is also a

network of longitudinal muscles around and over the cloaca which keeps up a rhythmic contraction that greatly assists circulation.

These have already been mentioned as one of the chief agents in the larval circulation prior to the development of the heart, and they seem to retain their function in the adult.

Respiration has been already fully discussed in the larva, and there is nothing to be added here. It may be well to repeat that respiration is integumental, and that it is not confined exclusively to the abdomen. The lobes of the carapace have a respiratory function as important as that of the abdomen, and become the chief centers for blood purification in those species (*catostomi*, etc.) whose abdomen is comparatively very small.

The nervous system is well developed, and consists of a dorsal brain connected with a ventral chain of ganglia, and nerves running to the various appendages. The brain consists of two portions, each of which is lobed (fig. 20). The upper part is situated just beneath the skin on the dorsal midline of the carapace, right over the common base of the mouth and sting. Its three lobes have an outline and arrange-

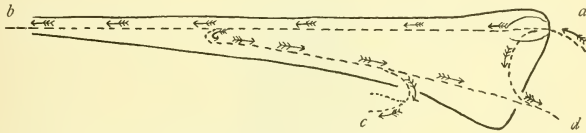


FIG. 19.—SIDE VIEW OF THE HEART OF ARGULUS AMERICANUS (DIAGRAMMATIC). (FOR LETTERING SEE FIG. 18.)

ment similar to that of the parts of a clover leaf. The outer rounded portions are almost transparent, but the inner borders, where the three come in contact, are heavily pigmented, and show through very prominently as a dark brown, almost black, triangular spot. The under part is much larger than the upper, is more oval or elliptical in shape, and extends some distance in front of the pigment spot. It is divided along its longitudinal or antero-posterior diameter into two lobes, each of which passes insensibly at the anterior end into a thick nerve running to the eye on that side. In most species these optic nerves have a good-sized swelling, the optic ganglion, on their outer borders just before reaching the eyes.

The posterior ends of the lobes also pass insensibly into thick-set commisures, which curve around the œsophagus on either side and connect with the interior ventral ganglion.

At the point where they leave the lobes there is a considerable swelling, the "*schlundganglion*" (Claus). From this swelling a nerve runs forward to the posterior antennæ. There is also another nerve leading to the anterior antennæ from some portion of this ventral part of the brain, but I have been unable to locate it any more exactly than Claus.

The ventral chain consists of six ganglia placed so near together that they are almost completely fused. But they can still be distinguished clearly by the transverse grooves and constrictions between them (fig. 20). They diminish in size from in front backward, the anterior one being about twice the diameter of the posterior. From the anterior ganglion a stout nerve (there are several others leading from

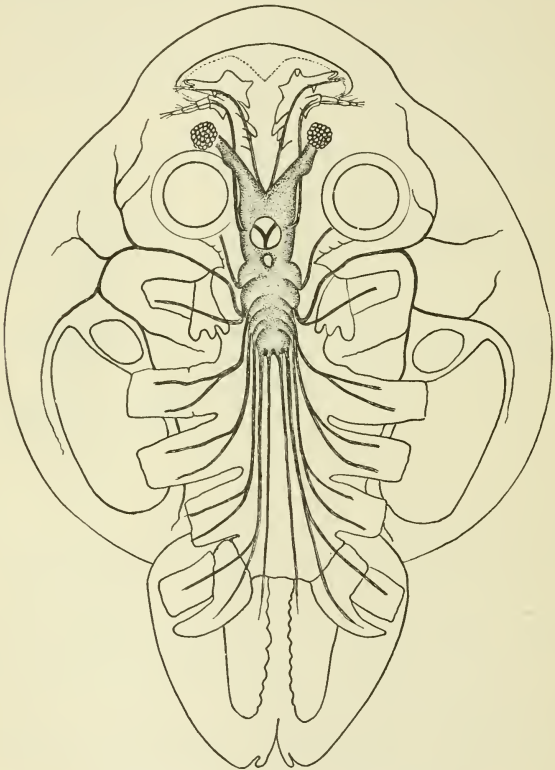


FIG. 20.—THE NERVOUS SYSTEM OF ARGULUS AMERICANUS.

the same ganglion in *coregoni* according to Claus's figure) is given off on either side which divides quickly, the anterior branch innervating the mouth parts, while the posterior branch passes out into the carapace. Another stout nerve is given off usually from the second ganglion¹ which divides and innervates the two pairs of maxillipeds.

¹ Leydig states that this nerve comes from the first ganglion in *foliaceus*. Claus gives it from the second ganglion in *coregoni*, an arrangement which exists, also in *americanus* and *versicolor*. It has not yet been located in other species.

From each of the other ganglia is given off a pair of nerves (two pairs in *coregoni*) which run diagonally backward and innervate the swimming legs in order. From the posterior ganglion two pairs of nerves in the American species and *foliaceus*, and three in *coregoni*, run directly backward along the ventral wall of the intestine. The outer of these two pairs goes to the posterior swimming legs; the inner one runs into the abdomen and innervates its muscles, together with those of the heart. Especially worthy of notice are the innerva-

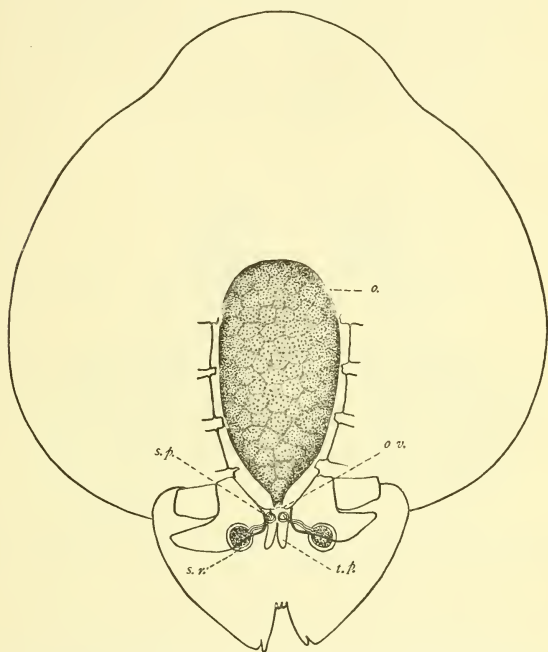


FIG. 21.—FEMALE SEXUAL ORGANS OF ARGULUS AMERICANUS. *o.*, OVARY; *ov.*, OVIDUCT; *s. p.*, SEMEN PAPILLE; *s. r.*, SEMEN RECEPTACLE; *t. p.*, TACTILE PAPILLE AT THE OPENING OF THE OVIDUCT.

tions of the basal lobes of the posterior swimming legs, which are used as tactile organs in egg laying, as already described, the innervation of the accessory sexual organs on the swimming legs in the male, and that of the tactile papillæ on either side of the opening of the oviduct in the female.

For sense organs the Arguli possess only eyes and tactile organs. The eyes are large in most species and are made up of 30 to 60 facets, spherical or ellipsoidal in form, but packed so closely together as to become more or less angular. The outer portions of these facets are free from pigment, but the inner portions are heavily pigmented.

The whole eye is usually spherical, but in a few species is somewhat elongated diagonally or crescent shaped.

Each eye is surrounded by a wide blood sinus through which the blood constantly flows, so that the eyes are continually bathed in it. The eyes are capable of moving inside these sinuses and often show a trembling motion similar to that in other copepods.

The tactile organs include the two pairs of antennæ, the original tactile function of the first pair being almost wholly superseded by the acquired function of prehension, the basal lobes on the posterior legs, and the long finger papillæ beside the opening of the oviduct in the female. There are also tactile setæ around the anterior half of the edge of the carapace, and some at least of the accessory organs in the male serve primarily as organs of touch (p. 697).

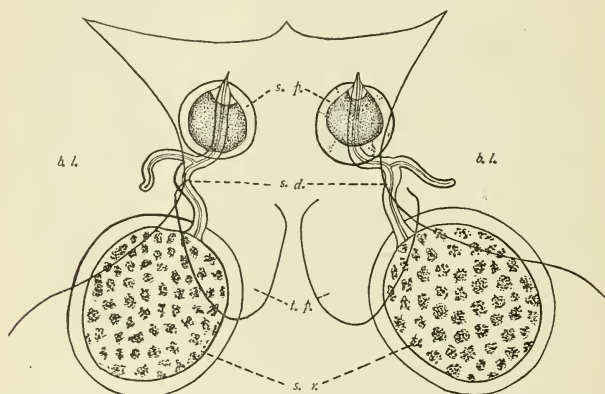


FIG. 22.—SEMEN RECEPTACLES AND PAPILLÆ OF ARGULUS AMERICANUS FEMALE UNDER GREATER ENLARGEMENT. *b. l.*, BASAL LOBES OF POSTERIOR LEGS; *s. d.*, DUCTS LEADING FROM THE RECEPTACLES TO THE PAPILLÆ; *s. p.*, SEMEN PAPILLÆ; *s. r.*, SEMEN RECEPTACLES; *l. p.*, TACTILE PAPILLÆ.

The sexual organs.—The sexes are separate, and the female is usually larger than the male, though there is no such difference in size as among some of the other parasitic forms. And in *laticauda* the males are actually larger than any females thus far found. The females are also considerably more numerous than the males.

The female sexual organs consist of an unpaired median ovary and paired seminal receptacles (fig. 21). The ovary starts as an unpaired ridge of cells along the right or left side of the intestine. In later development it migrates to the median line, and becomes a simple receptacle for holding the maturing eggs. It reaches from the stomach to the posterior end of the thorax, where it narrows abruptly into a short oviduct which opens out at the base of the sinus between the lobes of the posterior legs. In many species there is a long tactile

papilla on either side of this external opening, but some are without it. The walls of the ovary are muscular, and in most species exhibit peristaltic movements similar to those in the intestine. In some species the dorsal surface is beset with dark brown pigment spots, arranged in somewhat regular longitudinal rows. The eggs are spherical when first formed, and are each developed inside a small petioled bag, so that the whole mass takes on the appearance of a bunch of grapes.

As they grow they become ellipsoidal, and are finally packed together so tightly as to become angular. Between the egg and the membrane of the bag in which it is contained is a clear, jelly-like substance which forms a sort of shell around the egg. The semen receptacles are dark-colored spherical capsules lying in the anterior portion of the abdomen lobes near the cloaca (fig. 22). From each capsule a duct (*s. d.*) runs forward and inward to a hollow conical papilla (*s. p.*) situated nearer the midline on the ventral surface. This papilla is in the anterior end of an elliptical shield composed of several chitin plates, which covers the ventral surface of the abdomen around the papilla and holds it securely in place. Near the center of the duct is a blind appendage. The papillæ are strongly curved over inward toward the midline, and both they and the shield plates are capable of motion.

The outer end of the semen duct leading from the capsules fits into the papilla as into a sheath and can be withdrawn or extruded at will. Its tip is contracted and hardened into a sharp chitinous spine, and when extruded this spine projects from the tip of the papilla and comes in contact with the egg as the latter issues from the oviduct. When withdrawn the papilla is closed and the semen is confined to the receptacle and the proximal part of the duct.

Claus calls attention to the thickness of the eggshell and the consequent necessity of a micropyle through which the sperm may enter the egg. But he states that careful examination does not reveal any micropyle, and gives it as his opinion that the sharp chitin spine at the tip of the duct just noticed pierces the egg shell and makes thus a passage for the sperm.

However this may be, it is certain that the egg as it issues from the oviduct, and is grasped between the bases of the posterior legs and carried back into place on the underlying surface, must come forcibly in contact with this spine and receive from it a discharge of sperm.

The male sexual organs may be distinguished first as essential and accessory. The essential organs include the testes, an unpaired seminal receptacle, the ducts leading from the testes to the receptacle and from the receptacle to the sexual opening, and a pair of blind capsules connected with the latter ducts (fig. 23). The testes are situated in the lobes of the abdomen in a position corresponding to that of the

seminal receptacles in the female. They are much larger than the receptacles, however, and as a result the abdomen of the male is comparatively larger and longer than that of the female of the same species. The testes (*t.*) are ovoid or ellipsoidal in shape, and in nearly every species are covered on the dorsal surface with dark pigment spots corresponding to those on the dorsal surface of the ovary. From the

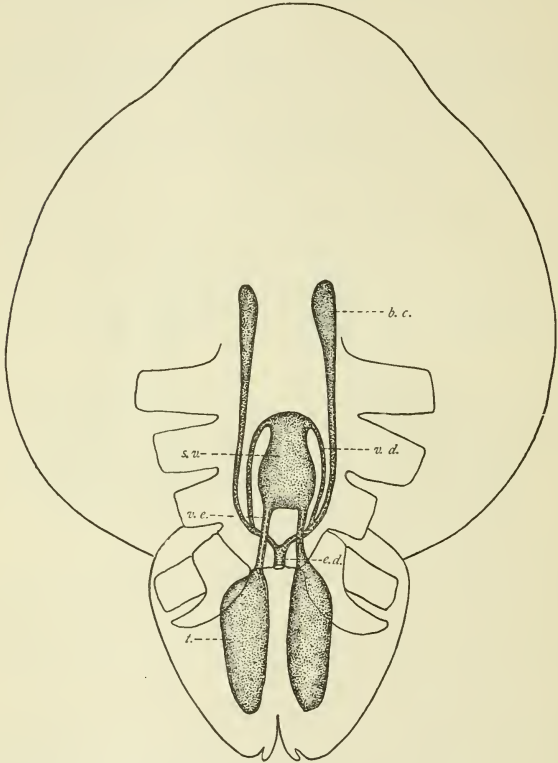


FIG. 23.—MALE SEXUAL ORGANS OF ARGULUS AMERICANUS. *b. c.*, BLIND CAPSULE; *e. d.*, EJACULATORY DUCT; *s. v.*, SEMEN VESICLE; *t.*, TESTIS; *v. d.*, VAS DEFERENS; *v. e.*, VAS EFFERENS.

anterior end of each testis there runs a duct, the vas efferens (*v. e.*), which leads forward to the unpaired seminal receptacle or vesicle (*s. v.*) lying in the posterior thorax on the midline, above the intestine.

The vasa efferentia enter the vesicle at its posterior end. From the anterior end there is given off on either side another duct, the vas deferens (*v. d.*), which turns backward alongside the vas efferens until

it reaches the posterior border of the thorax, where it turns downward and inward, meeting the corresponding duct from the other side on the midventral line and fusing in a very short, common ejaculatory duct (*e. d.*) which opens at the base of the sinus, between the lobes of the posterior legs, thus corresponding exactly to the opening of the oviduct in the female. Connected with the vasa deferentia on either side, just where they turn down to meet each other, is a pair of accessory blind capsules (*b. c.*). These are long and slender, and reach forward far beyond the seminal vesicle and are somewhat enlarged at their anterior ends so as to be club-shaped. All the ducts and the seminal vesicle exhibit peristaltic movements.

The accessory sexual organs of the male are used chiefly for copulation. They are situated upon the two or three posterior pairs of legs and vary greatly in the various species.

They are of two kinds, which may be called generic and specific. The generic parts, those which are present in all species without much modification, are a peg or blunt spine on the anterior surface of the distal end of the basipod of the posterior legs, and a semen capsule on the posterior surface of the legs next in front. The peg and the capsule face each other and are evidently supplementary in function.

So far as can be determined from preserved specimens, there are two general types of peg in the American species.

In one, represented by *funduli*, *megalops*, *alosa*, etc., the protuberance takes the shape of a spherical ball arising at the base of the exopod, but no tubercles can be seen on its surface corresponding to those found in *foliaceus* (Claus).

The ball is somewhat flattened dorso-ventrally and is supported on a short narrowed neck. Along the anterior surface of the basipod between the ball and the body is a groove formed by the raising of the edges of the basipod joints.

The ball can be elevated or partially depressed into this groove at pleasure. The ventral edge of the groove is not even, but is raised into a small flattened plate opposite the base of the ball and into another much larger one nearer the body.

These projections and a part of the ventral surface of the basipod itself are roughened by chitinous papillary elevations of the cuticle (Plates XI, XII, and XIV).

The other type of peg is present in *versicolor*, *lepidostei*, *americanus*, etc., and more closely resembles that described for *foliaceus*. It consists of a blunt papilla at the base of the exopod, very similar in form to that pictured by Claus for *foliaceus* and also covered with rough tubercles.

But from the center of the papilla there arises a long curved spine conical in shape and slightly enlarged at the very tip.

Its diameter is not more than a third that of the basal papilla, so that its point is quite sharp despite the fact that it is enlarged a trifle. On the ventral surface of the basipod are projections similar to those connected with the other type of peg, and a large triangular plate extending across the surface, both projections and plate being covered with rough chitin tubercles. The tissues around this kind of a peg are more transparent than in the other species and through them can be seen a muscle running from the very tip of the basal papilla diagonally backward to the posterior surface of the basipod, where it is attached to a small chitin thickening of the cuticle just at the tip of the triangular plate. This is the muscle which gives motion to the peg, and by it the narrow terminal part can be at least partially withdrawn into the wider basal portion. Alongside the muscle can be seen a good-sized nerve fiber which extends into the basal portion of the peg and indicates that the latter possesses a good sense of touch.

The same muscle and nerve exist in the previous type, but can not be seen as readily through the more opaque tissues (Plates XV, XX, and XXI). The semen capsule is quite a deep, pocket-shaped cavity on the posterior border of the third pair of legs opposite the peg. While the peg is confined exclusively to the distal basipod joint, both segments of the basipod share in the formation of the capsule, according to Claus.

In most species the bulk of the capsule is on the distal joint, but in at least two species, *funduli* and *megalops*, it is almost wholly on the basal joint. The lumen of the capsule is closed by flaps projecting over it from the surrounding tissues. These flaps are held open by the peg on the posterior legs while the capsule is being filled with sperm.

In addition to this peg and capsule there are various specific modifications of the three posterior legs.

These take the form of processes of various shapes attached to the anterior, the posterior, or to both surfaces of the basipods. In *megalops* the basal joint of the third legs is well rounded posteriorly and has a large thumb-shaped projection at its distal anterior corner, giving it much the appearance of a hand denuded of its fingers (Plate XI).

In *laticauda* the basipods of the third legs project posteriorly in two long flaps on each joint, the outer one narrow and finger-like, the inner one broad and well rounded (Plate X).

There are two exactly similar but rather larger projections on the posterior border of the basal joint of the second legs.

In *versicolor* there is a small finger projection from the outer end of the basal joint of the third legs on their posterior surface and a very large conical one in a similar position on the second legs. The distal basipod joint of the third legs also has a rounded knob on its anterior surface (Plate XX).

In *lepidostei* the basal joint of the second legs projects posteriorly as an enormous flap, and there is a rounded knob on the anterior surface of the distal basipod joint of the third legs similar to that in *versicolor* (Plate XVI).

In *maculosus* there is a more plentiful supply of projections and knobs; projections posteriorly at the outer ends of the basipods of the third legs and of the basal joint of the second legs, and an anterior projection at the outer end of the basal joint of the third legs; knobs on the posterior surface of the distal basipod joint of the fourth legs, on the anterior surfaces of both joints of the third legs and the same surface of the basal joint of the second legs (Plate XIX).

But it is in *americanus* that the projections reach the maximum for any species so far examined. Here at the outer end of the basal joint of the third legs on its anterior surface arises a long club-shaped projection which reaches past the distal basipod joint and extends far out on the exopod.

There is another conical projection, only slightly smaller, exactly opposite on the posterior surface of the preceding pair of legs. Both projections are profusely covered with setæ. There are also smaller projections on the opposite surfaces of the same joints as bear the large ones (Plate XXI).

SYSTEMATIC.

The Argulidæ were classed by Krøyer with the Siphonostoma, but Zenker in 1854 withdrew them from this group in consequence of a mistaken interpretation of the mouth parts.

Later Thorell placed the Argulidæ as a third suborder of the Branchiopoda, of equal value with the Phyllopods and Cladocera, giving as his particular reasons the unfaçetted cornea of the compound eyes, the absence of palps or branchial appendages on the oral organs, the absence of external egg sacs and spermatophores, and the fundamental form of their extremities.

But Claus in 1875 showed very clearly that the Argulidæ are much more closely related to the Eucepepoda than to the Branchiopods, and while retaining the name Branchiura given them by Thorell, he places them under the Copepoda as a second suborder of equal value with the Eucepepods.

That Claus is right and that the Argulidæ are much more closely related to the Eucepepods than to the Phyllopods has been clearly shown in the preceding ontogeny and morphology in the following points:

1. They have a flattened body which shows exactly the same general form as in the less degenerate Siphonostoma (Caligidæ, etc.), the same division into regions, and the same segmentation, part for part. The head is fused with the first thoracic segment, while the other thoracic

segments are free, and the abdomen is unsegmented. On the contrary, the only Phyllopod having a head shield is *Apus*, and even here the first thoracic segment is not fused with the head. The Phyllopod thorax contains many segments and the abdomen is also segmented.

2. They have the same number and grouping of the appendages as would naturally follow from the similarity in segmentation, and this grouping is entirely different from that in the Phyllopods.

3. They have two pairs of antennæ, one of which has been modified into fixing organs.

4. They have two pairs of maxillipeds, which in the larval state are quite like those of the *Siphonostoma* in form and function and are presumably of the same origin. That the anterior pair is afterwards modified into sucking disks in no way affects their relationship. It is what might be expected as a result of their parasitic habits. There are no such posterior maxillary appendages in any of the Phyllopods.

5. The mouth apparatus consists in part of a proboscis formed from the lips and jaws in a very similar way to that of the *Siphonostoma* and bearing no resemblance to that of the Phyllopods. The other part, the sting with its poison glands, is a distinctive organ, found in no other Crustacean group, and therefore to be left out of account as of no value in showing relationship.

6. The ovary is unpaired even from its beginning and though the oviduct is at first paired, one side is afterwards atrophied. The females also possess semen receptacles which differ somewhat in size and arrangement from those of the *Eucopepods*, as would be expected. But their general position, structure, and mode of operation is the same. In Phyllopods the ovaries are nearly always paired, at least in the larval period, and the semen receptacles, when present, are entirely different in position and mode of operation.

7. The swimming legs are elongated, two-branched appendages with distinctly segmented basipods, and long endopods and exopods, furnished with plumose setæ. On the two anterior legs about half the species have a flagellum attached to the basipod and pointing inward dorsally. There is nothing here which corresponds even in the remotest degree to the characteristic Phyllopod foot with its unjointed stem, its six inner lobes or appendages (endites), and its outer flat respiratory plate and sac-like branchial appendage. The *Argulidæ* breathe by means of their flattened carapace and abdomen, the Phyllopods by means of their gill-feet.

Such resemblances are conclusive, and in view of the further fact that the only particulars in which the *Argulidæ* differ at all essentially from the *Eucopepods* are such as would naturally be expected in two parasites, even if they were closely related, we may confidently adopt *Claus's* classification as correct.

Order COPEPODA Müller.

Of small size, with an elongated body distinctly segmented, except in degenerate parasitic forms. Head carapace often fused with the first thoracic segment. Four or five pairs of biramous rowing legs on the thorax and an abdomen without appendages.

(κῶπιη, = an oar, πούς, = foot.)

Suborder BRANCHIURA Thorell.

A flattened body, consisting of a shield-shaped cephalothorax in which the first thoracic segment is fused with the head, a free thorax of three segments, and a two-lobed abdomen without segments. Four pairs of swimming feet, long and furnished with two rows of plumose setæ. Two large compound eyes, movable and surrounded by a blood sinus. Testes in the abdomen. Heart present. Females without ovisacs; eggs attached to foreign objects.

(βράγχια = gills, ὄυρα = tail.)

Family ARGULIDÆ Müller.

The single family so far known of course possesses the same characteristics as the suborder. (*Argulus* = a diminutive of *Argus* in allusion to the number of parts in the compound eyes.)

ARTIFICIAL KEY TO GENERA AND SPECIES.

[The relative size of the anterior maxillipeds and the abdomen are expressed in decimal fractions; the former are fractional parts of the width of the carapace, the latter of the entire length of the animal, exclusive of the abdomen.]

- I. First maxillipeds modified into sucking disks.
 - II. Two pairs of antennæ, the anterior armed with stout hooks; preoral sting present *Argulus*
 - II. Only one (the posterior) pair of antennæ; no preoral sting *Chonopeltis*
- I. First maxillipeds with barbed claws; no sucking disks; no preoral sting *Dolops*

ARGULUS.

- A. Carapace lobes overlapping the base of the tail.
- B. Anterior swimming legs with a flagellum.
- C. Carapace orbicular, wider than long.
 - D. Teeth of basal plate wide and blunt, swimming legs reaching considerably beyond the edge of the carapace.
 - 1. Diameter of sucking disks, 0.25; spines on antennæ reduced in number, small and weak; abdomen relatively very small and orbicular..... *catostomi*, p. 709
 - 2. Diameter of sucking disks, 0.15; spines on antennæ large and strong, reinforced; abdomen very large and broadly cordate *americanus*, p. 718
 - D. Teeth of basal plate narrow and sharp; swimming legs not reaching the edge of the carapace.
 - 3. Abdomen very small, 0.1, orbicular, with wide blunt lobes; sucking disks 0.2 to 0.25 *nattereri*, female, p. 720

4. Abdomen medium, about 0.25, wider than long; lobes on basal joints of posterior legs oval, and *half the length of the legs* *indicus*, p. 727
5. Diameter of sucking disks, 0.1 to 0.12; abdomen large, 0.33, elongated, with lanceolate-acuminate lobes *coregoni*, male, p. 724
- C'. Carapace elliptical, considerably longer than wide.
6. Sucking disks, 0.25, situated very far forward; abdomen narrow, ovate, cut far beyond the center; color a uniform black, lighter on the ventral surface. *niger*, female, p. 714
7. Sucking disks, 0.2, not far forward, but nearer the center of the carapace; abdomen wide, elliptical, cut barely to the center; color greenish yellow. *pugettensis*, p. 711
- B'. Swimming legs without flagella.
8. Carapace covering the whole of the abdomen; last thoracic segment with lobes overlapping the abdomen (*giganteus* of Lucas) *purpureus*, p. 723
- A'. Carapace lobes just reaching the base of the abdomen.
- B. Anterior swimming legs with flagella.
- C. Carapace orbicular, wider than long.
- D. Abdomen broadly triangular; anal sinus not reaching halfway to the center; legs extending beyond the carapace.
9. Anal sinus narrow and slit like; anal papillæ subterminal; bases of antennæ close to mid line of carapace *versicolor*, male, p. 716
10. Anal sinus broad triangular; anal papillæ lateral; bases of antennæ widely separated *maculosus*, p. 715
- D'. Abdomen long elliptical; anal sinus cut fully to the center; lobes acuminate; legs entirely covered by carapace.
11. Anal sinus narrow; papillæ basal *coregoni*, male, p. 724
- C'. Carapace elliptical, considerably longer than wide; abdomen broadly elliptical; abdominal sinus short, well rounded.
12. Sucking disks about 0.25; legs not nearly reaching the edge of the carapace. *salmini*, male, p. 720
13. Sucking disks less than 0.25; legs reaching beyond the carapace. *laticauda*, male, p. 705
- A". Carapace lobes not reaching the abdomen.
- B. Anterior swimming legs with full-sized flagella.
- C. Carapace orbicular, wider than long, covering three pairs of legs, almost reaching the abdomen.
14. Abdomen large, elliptical, cut beyond the center, with acute lobes; legs reaching beyond the edge of the carapace *coregoni*, female, p. 724
15. Abdomen very small, orbicular; anal sinus short, lobes well-rounded; legs not reaching the edge of the carapace *salmini*, female, p. 720
16. Abdomen medium, oval; anal sinus short, slit like, papillæ subterminal; color variegated *versicolor*, female, p. 716
17. Abdomen small, elliptical, not cut to the center, with rounded lobes; lobes on posterior legs large, hatchet-shaped *africanus*, p. 727
18. Abdomen large, 0.63, cut beyond the center; papillæ lateral, about one-quarter the distance from the base of the sinus; longitudinal ribs forked at the anterior end *phoxini*, p. 728
- C'. Carapace elliptical, considerably longer than wide.
- D. Abdomen broadly elliptical, not cut a third of its length, lobes broadly rounded; sucking disks less than 0.12.
19. Carapace lobes short and entirely free from the thorax, with spaces between; teeth on basal plate narrow and sharp *chromidis*, female, p. 721
20. Carapace lobes long and overlapping the thorax; teeth on basal plate wide and squarely truncated; posterior maxillipeds large, well-armed. *laticauda*, female, p. 705

21. Carapace abruptly rounded posteriorly, narrowed anteriorly; teeth on basal plate long and sharp; anal sinus wide and shallow *japonicus*, p. 727
 D'. Abdomen cut to or beyond its center with acute lobes; sucking disks 0.2 to 0.25.
22. Carapace lobes very short, barely covering two pairs of legs; abdomen broad triangular; anal sinus also broad triangular; papillæ lateral near the tips. *lepidostei*, p. 712
23. Carapace lobes covering three pairs of legs; abdomen narrow elliptical; anal sinus narrow; papillæ basal..... *foliaceus*, p. 722
- B'. Flagella on second swimming legs rudimentary.
24. Lateral sinuses in the carapace very deep; legs completely covered. *scutiformis*, p. 728
- B''. No flagella on the swimming legs.
- C. Carapace orbicular, wider than long; sucking disks enormous, 0.33; second maxillipeds small and weak.
25. Basal plate with 3 stout teeth; legs very long; lobes on posterior legs large, boot shaped; color light yellowish white..... *funduli*, p. 710
26. Basal plate prolonged posteriorly as an entire lobe without teeth; lobes on posterior legs small; color a light brown *latus*, p. 704
- C'. Carapace elliptical, longer than wide.
- D. Abdomen medium, 0.23, as broad as long, cut less than one-third; lobes broad and well rounded.
27. Antero-lateral sinuses narrow and small; cephalic area not projecting beyond the outline of the rest of the carapace; carapace not covering the bases of the third pair of legs..... *megalops*, p. 706
28. Cephalic area projecting considerably beyond the carapace outline, with a rounded protuberance on either side, medium sized in the female and in front of the sinus, very large in the male and posterior to the sinus. Carapace covering the third legs entirely *dactylopteri*, p. 726
- D'. Abdomen elongate, 0.3 to 0.45, cut to the center or beyond, lobes lanceolate-acuminate.
29. Three short teeth on the basal plate; no lobes on posterior legs; sucking disks well forward; lateral sinuses of carapace shallow *aloue*, p. 707
30. Only 2 teeth on the basal plate; very long acuminate lobes on posterior legs; sucking disks very far back; lateral sinuses deep..... *melita*, p. 725
31. Lateral rings of carapace fused into a single club-shaped one; teeth on basal plate particularly long and sharp..... *stizostethii*, p. 713
- A'''. Carapace very short, without posterior sinus or lobes, covering neither thorax, abdomen, nor feet.
32. Abdomen cut to the base, with lanceolate lobes; basal plate of second maxillipeds without teeth *elongatus*, p. 722

CHOXOPELTIS.

33. Carapace covering only first and second swimming legs; rudimentary flagella on first legs only; no teeth on basal plate of second maxillipeds.

inermis, p. 729

DOLOPS.

- A. Carapace lobes reaching posteriorly beyond the base of the abdomen.
- B. Carapace suborbicular, wider than long.
34. Carapace entirely covering the feet; abdomen obovate, cut about one-third; anal sinus slit-like *discoidalis*, p. 739
- B'. Carapace obovate, longer than wide.
35. Carapace entirely covering the feet; abdomen small and narrow, about 0.25, diamond-shaped; color grayish white, marbled with black dorsally.

kollari, p. 732

36. Carapace entirely covering the feet; abdomen larger, 0.33; broadly orbicular; color green, marbled with blue.....*striata*, p. 735
37. Carapace narrowed anteriorly, not covering the feet; abdomen still larger, 0.4, broadly triangular; color a uniform dark green.....*reperta*, p. 734
- A'. Carapace lobes just reaching the base of the abdomen.
- B. Carapace elliptical, longer than wide.
- C. No spines on the ventral surface; swimming feet reaching well beyond the edge of the carapace.
38. Carapace wider anteriorly; abdomen 0.5; anal sinus narrow, diamond-shaped, with the papille in the angles of the diamond; testes three-lobed.
raurum, p. 737
39. Carapace wider a little behind the center; abdomen 0.65; anal sinus triangular; lobes widely divergent, acuminate; papille basal; testes two-lobed.
geayi, p. 736
- A''. Carapace lobes not reaching the abdomen.
- B. Carapace orbicular, wider than long.
- C. Abdomen cut almost to the base; no spines on the ventral surface of the carapace.
40. Abdomen medium, 0.33; lobes widely divergent and acute.....*doradis*, p. 733
41. Abdomen very long, 1-5 to 2; lobes nearly parallel and acuminate.
longicauda, p. 732
- C'. Abdomen cut less than one-half; ventral surface well armed with spines.
42. Abdomen short, 0.27, orbicular; basal plate of maxillipeds with only two teeth.....*bidentata*, p. 736

No figure of *Argulus africanus*, *indicus*, *japonicus*, or *scutiformis*, or *Chonopeltis inermis*, has ever been published.

ARGULUS Müller.

The genus possesses the same characteristics as the family and is distinguished from other genera by the presence of a sheathed stylet or sting in front of the mouth, used for a piercing organ. The anterior maxillipeds are transformed into sucking disks, while the posterior ones are armed with setæ, spines, and a chitinous plate upon their basal joint.

This plate is elevated above the surrounding surface and roughened by spines or warts, and is prolonged into three sharp spines on its posterior border. There are two pairs of antennæ, the anterior of which are armed with stout sickle-shaped hooks and function as organs of prehension. The basal joints of the posterior swimming legs are usually prolonged into lobes projecting beneath the abdomen.

ARGULUS LATUS Smith.

Plate IX.

Argulus latus SMITH, Invertebrate Animals of Vineyard Sound, Report of U. S. Com. Fish and Fisheries, 1872.—RATHBUN, Annotated List of Parasitic Copepoda, Proc. U. S. National Museum, VII, 1884.

Carapace orbicular, wider than long; posterior sinus about one-fifth the length of the carapace, as wide as long; abdomen a third as long as the carapace, two-thirds as broad as long, the lateral margins slightly curved and nearly parallel; anal sinus very broad, about one-third the

whole length; anal papillæ basal. Disks of the anterior maxillipeds nearly one-third the width of the carapace; plate at base of posterior maxillipeds prolonged backward as a whole, without teeth or lobes; ultimate segment longer than the penultimate, hooks short and blunt.

First antennæ very short, without any hook on their anterior margin; second antennæ also short; swimming legs all reaching beyond the edge of the carapace. No flagella. Color yellowish-white.

Length, 2.3 mm.; length of carapace, 2.2 mm.; width of carapace, 2.5 mm.; length of abdomen, 0.7 mm.; breadth of abdomen, 0.45 mm. Male unknown.

6181. Vineyard Sound, Massachusetts; U. S. Fish Com., July, 1871; one female, the type, taken at the surface. ————. Casco Bay, Maine; U. S. Fish Com., 1873; one female, no data. 6184. Quahaug Bay, Maine; host not given.

(*latus* = wide.)

ARGULUS LATICAUDA Smith.

Plate X; Plate XXVI, fig. 79.

Argulus laticauda SMITH, Invertebrate Animals of Vineyard Sound, Report of U. S. Com. Fish and Fisheries, 1872.—RATHBUN, Annotated List of Parasitic Copepods, Proc. U. S. National Museum, VII, 1884.

Carapace elliptical, longer than wide; posterior sinus about one-third the length of the carapace, twice as deep as wide.

Abdomen orbicular, slightly longer than broad; anal sinus narrow, extending scarcely a fourth the length; anal papillæ basal.

Disks of anterior maxillipeds small, about one-eighth the width of the carapace, placed well back; basal plate on posterior maxillipeds narrow, but expanding into a wide posterior margin, cut into three broad, squarely truncated lobes. A papillated area near the center of the plate; a row of spines along the posterior margin of the three basal joints. Spines on the bases of the antennæ large, broad, and blunt. Males much larger comparatively than in other species, the basal joints of their three posterior pairs of legs prolonged backward into fleshy lobes, the outer ones narrow and finger-like, the inner ones occupying the remainder of the joint. Flagella present.

Length of male 5 to 6 mm.; length of carapace 3.5 to 4 mm.; width of carapace 3.2 to 3.5 mm.; length of abdomen 1.3 mm., breadth 1.1 mm.

Smith's types were two females taken from among algae in Vineyard Sound, Massachusetts, in August, 1871 (Museum number, 6182).

Since then they have been obtained in large numbers from various fishes, those in the National Museum collection being numbered as follows: From the Eel (*Anguilla chryssypa* Rafinesque), Nos. 1311, 1318, and 1398, collected by V. N. Edwards; 6013¹, 6013², 6177, 8278, 8279, 12294; a lot from Katama Bay by Thompson. From Flatfish (*Pseudopleuronectes americanus* Walbaum), Nos. 1433, V. N. Edwards; 6152, 6171; a lot from Katama Bay by Thompson, another from Woods Hole

by H. M. Smith. From Blenny (sp.), No. 6054. From Skate (sp.), No. 12302. From Sculpin (sp.), No. 12291. From "Bonnet Skate," one lot by Thompson. From Tomcod (*Microgadus tomcod* Walbaum), No. 15446. From Summer Flounder (*Paralichthys dentatus* L.), one lot by Thompson.

Color a mottled black, except at the very edge of the carapace, back of the eyes, and around the brain, where it is yellowish; the mottlings vary much in different individuals in size and extent, and are sometimes reddish brown.

This still continues, as Rathbun stated in 1884, the most abundant of the genus among the salt-water forms, though *megalops* is found on a greater variety of hosts.

(*latus*=wide, *cauda*=tail).

ARGULUS MEGALOPS Smith.

Plate XI; Plate XXVI, fig. 81.

Argulus megalops SMITH, Invertebrate Animals of Vineyard Sound, Report of U. S. Com. Fish and Fisheries, 1872.—RATHBUN, Annotated List of Parasitic Copepods, Proc. U. S. National Museum, VII, 1884.

Carapace elliptical, longer than broad; antero-lateral sinus narrow and deep, posterior sinus narrow triangular and shallow; abdomen broad elliptical, two-thirds as broad as long; anal sinus narrow and short; papillæ basal. Sucking disks medium size, situated well forward; basal plates on posterior maxillipeds, as well as the maxillipeds themselves, large and fully armed. The median spines between these posterior maxillipeds are slender and strongly curved. Antennæ rather slender, armed with narrow, sharp spines and hooks. Eyes quite large, their diameter about one-tenth that of the carapace.

Swimming legs long, projecting some distance beyond the carapace; lobes on the basal joints of the posterior legs in the female with a narrow, conical projection pointing outward. No flagella.

The peg on the posterior legs of the male takes the shape of a flattened spherical ball with a short, narrowed neck.

On the side of the peg next the body there is a groove in the anterior surface of the basipod into which the ball can be partially depressed. On the basal joint of the third legs is a stout thumb-shaped projection extending forward from the distal end of the joint. Smith's three type specimens were females taken at the surface in Vineyard Sound, Massachusetts, July 8, 1871. They were evidently young females, since those since obtained are much larger, as will be seen from the measurements here given. This species has a larger number of hosts than any other thus far found, the most common one being the Flatfish (*Pseudopleuronectes americanus* Walbaum). The Museum numbers for this fish are 1322, 1460, and three unnumbered lots from Woods Hole by V. N. Edwards; 8276, 8238 (in part), 12032, 12295, 12296; two unnumbered lots by Thompson, one from Woods Hole and the other

from Menimsha; an unnumbered lot off Cape Cod. From Sand Dab (*Hippoglossoides platessooides* Fabricius), Nos. 1407 by V. N. Edwards; an unnumbered lot by Thompson from Woods Hole. From Summer Flounder (*Pardichthys dentatus* Linnaeus), Nos. 6067, 8638. From Spotted Flounder (*Lophopsetta maculata* Mitchill), No. 6069. From Sea Robin (*Prionotus carolinus* Linnaeus), Nos. 8275, 8639; one unnumbered lot by Thompson. From Sculpin (*Myoxocephalus octodecimspinosus* Mitchill), Nos. 8281, 12290. From Tomcod (*Microgadus tomcod* Walbaum), No. 8280. From Goosefish (*Lophius piscatorius* Linnaeus), No. —, Woods Hole. From Minnow (sp.), No. 6105. From Flounder (sp.), No. 12297. From surface tow, No. 6179 (types); one lot unnumbered, Woods Hole. No host given, two lots, August 13 and November 21, 1885, by V. N. Edwards.

On examining this list and the one previously given for *A. laticauda* it will be seen that both species infest fishes which live on or very near the bottom. With the exception of those taken in the surface tow, whose presence has already been explained (p. 645), there is no deviation from this rule.

Hence, although the Arguli may and do change about quite freely from fish to fish, especially during the breeding seasons, it would seem as though they did not vary their level very much.

And in a plankton distribution we might reasonably expect to find at least these two species pretty definitely located. The hosts of some of the other species do not stay quite so closely at the same level, and hence the range of the parasite would be enlarged by that of its host.

Length, 6 mm.; length of carapace, 3.8 mm.; width of carapace, 3.5 mm.; length of abdomen, 2 mm.; breadth, 1.4 mm.

Color in fresh specimens yellowish, with four delicate pale brown longitudinal bands. The entire upper surface of the abdomen in ripe females is a red brown inclining to pink, thickly sprinkled with minute black dots. The lateral flaps of the carapace are also ornamented with an arborescent design in black pigment, similar to that shown in the photograph of *aloseæ* (fig. 80). After death the females frequently become a uniform bright pink.

(μέγας = large, ὄφ = eye.)

ARGULUS ALOSÆ Gould.

Plate XII; Plate XXVI, fig. 80.

Argulus alosæ GOULD, Invertebrata of Massachusetts, 1841.—THORELL, Om tvenna Europeiske Argulider, etc., Öfvers. af Kongl. Vetensk.-Akad. Förhandlingar, 21st series, Stockholm, 1864.—SMITH, Invertebrate Animals of Vineyard Sound, Report of U. S. Com. Fish and Fisheries, 1872.—RATHBUN, Annotated List of Parasitic Copepods, Proc. U. S. National Museum, VII, 1884.

Carapace elliptical, longer than wide; antero-lateral sinus shallow but often becoming deep and sharp on shrinking in alcohol, so that the cephalic area protrudes in a sort of semicircle.

Posterior sinus rather narrow, about one-third the length of the carapace, three times as long as wide; lobes well rounded.

Sucking disks large, about one-fifth the width of the carapace; posterior maxillipeds medium with a triangular basal plate armed with three short blunt teeth, and strongly papillated.

Antennae small and armed with rather weak spines and hooks. The body projects considerably beyond the carapace, the thoracic segments being long and wide; the posterior one projects over the abdomen as a well-rounded lobe on either side with a shallow sinus between. Abdomen broad and long, more than one-third the length of the rest of the body, with well-rounded lateral margins. Anal sinus broad triangular, cut to the center, leaving the two lobes sharply pointed and flaring slightly at their tips; papillae small and basal. Swimming legs long, projecting far beyond the carapace; lobes on the basal joints of the posterior pair small and rectangular. Abdomen in the male very much longer, but no modifications of the legs except the regular peg and semen vesicle. No flagella.

Length, 7.8 mm.; length of carapace, 4.8 mm.; breadth of carapace, 3.8 mm.; length of abdomen, 2.2 mm.; breadth, 1.7 mm.

Color, a yellowish white, mottled along the carapace lobes with brown. Some specimens measure 12 by 6 mm. (See photograph, fig. 80.)

This species was discovered by Dr. T. W. Harris in 1841 upon the gills of the alewife (*Clupea vernalis* Mitchell).¹

The single specimen was sent to Dr. A. A. Gould for determination and description; he published a very short and meager description accompanied by a coarse woodcut, from neither of which could any specific characters be determined. The species has rested upon this unsatisfactory basis ever since and has of necessity been more or less doubtful. It is hoped that the present description and figures will establish it satisfactorily. It occurs in considerable abundance along the Atlantic coast, but has never yet been found on any species of shad, which makes its name rather inappropriate.

The Museum collection includes: From the alewife (*Pomolobus pseudoharengus* Wilson), Nos. 1310 (by V. N. Edwards), 12680, 11619. From the smelt (sp.), an unnumbered lot, Woods Hole. From unknown hosts, Nos. 4410 from Great Egg Harbor; 7739 from Key West, and two unnumbered lots, one from Woods Hole and the other from Patchogue, Long Island. This Argulus has also been doubtfully recorded by Mr. J. F. Whiteaves as attached to *Gasterosteus biculeatus* Shaw, in the Gulf of St. Lawrence.

(*alosa* = from *alosa*, the supposed generic name of its host; *clupea* would be far more appropriate).

¹ Gould identifies this fish as the European *Alosa vulgaris*, but this form does not occur on our coasts, while the alewife is quite common and from it have been obtained most of the recent specimens.

ARGULUS CATOSTOMI Dana and Herrick.

Plate XIII.

Argulus catostomi DANA and HERRICK, Description of the *Argulus catostomi*, Amer. Jour. Sci., XXXI, 1837.—MILNE-EDWARDS, Hist. Nat. des Crustacés, III, 1840.—THORELL, Om tvänna Europeiske Argulider, etc., Öfvers. af Kongl. Vetensk.-Akad. Forhandlingar, 21st series, Stockholm, 1864.

Carapace orbicular, wider than long; posterior sinus nearly one-third the length of the carapace, broad with parallel sides. Abdomen orbicular, wider than long, but relatively very small, not more than one-fourth the length of the carapace; anal sinus narrow, almost slit-like, scarcely one-third the whole length of the abdomen; papillæ basal.

Disks of the anterior maxillipeds large, nearly one-fourth the width of the carapace broad as the latter is; posterior maxillipeds also large, every joint with a roughened area on its ventral surface; basal plate broad triangular, with wide lobes on its posterior edge instead of teeth, sometimes two and sometimes three. Antennæ small and weak, the anterior pair without a hook on their front margin, while the spines on the bases of both pairs are reduced to two insignificant pimples.

The anterior swimming legs scarcely reach the edge of the carapace; lobes on the posterior pair large, boot-shaped.

A large papilla present on either side of the opening of the oviduct. The arrangement of the chitin rings in this species is characteristic; the larger one extends along the edge of the carapace lobe as far forward as the sucking disks; at about the center of its inner surface is a deep indentation into which the smaller ring fits snugly, the latter being situated in the clear space just behind the posterior maxillipeds. Flagella present. Eyes quite small.

Length, 12 mm; length of carapace, 9.6 mm; breadth of carapace, 11.2 mm; length of abdomen, 2.3 mm; breadth, 2.4 mm.

Color a light sea-green, inclined to yellowish, growing quite dark in alcohol.

This was the first American species to be described, and with the possible exception of *funduli* and *pugettensis* it is the only one that has ever been given anything like a decent figure. For this reason it has been willingly accepted by the European zoologists, and has taken the same place in American parasitic copepods that *A. foliaceus* occupies in the European fauna.

It was first discovered on a sucker (probably *Catostomus bostonensis* Le Sueur) in brackish water near New Haven, Connecticut.

It has recently been found abundantly by the author upon the same sucker in fresh water at Warren and Chicopee, Massachusetts.

But it is even more abundant upon the chub sucker (*Erimyzon succetta oblongus* Mitchill), which is nearly always found with the other

species in these inland waters. It stays within the gill cavity, and has never yet been found upon the external surface, but there is every reason to believe that at least the males come out upon the external surface during the spawning season. The National Museum collection contains specimens from both the above localities and also a single specimen, a female, taken from carp at Fairburg, Illinois. None of these lots are numbered. In all probability future investigation will discover this species wherever the sucker is found in the United States.

(*catostomus* = generic name of its most common host, the sucker.)

ARGULUS FUNDULI Kröyer.

Plate XIV.

Argulus funduli KRÖYER, Naturhist. Tidsk. 3die Raekke, 2 Bind, 1863.—THORELL, Om tvenna Europeiske Argulider, etc., Öfvers. af Kongl. Vetensk.-Akad. Forhandlingar, 21st series, Stockholm, 1864.

Carapace orbicular, broader than long; posterior sinus less than one-fifth the length of the carapace, wider than deep, in the female nearly as two to one. Abdomen in the male fully one-half the length of the rest of the body, nearly three times as long as wide, with a narrow anal sinus less than a fourth of its length. Abdomen in the female much smaller, less than a third the length of the carapace, three-fifths as wide as long, with a wide anal sinus half its length; papillæ basal.

The sucking disks are relatively the largest of any American species, being almost one-third the width of the carapace; posterior maxillipeds correspondingly small and weak; teeth on the basal plates short and blunt. Antennæ of moderate size and fairly well armed. The whole ventral surface of the thorax roughened in the female. Swimming legs long, reaching well beyond the edge of the carapace; basal joints of the posterior legs in the female with medium-sized, rather rectangular lobes; these lobes much diminished in size in the male, and conical.

Eyes very large, fully the size, relatively, of those in *megalops*.

Pigment on the upper surface of the ovary and testes rather more plentiful than in most species. No flagella.

Length of female 5 mm., of male 3.3 mm.; length of carapace, female 3.1 mm., male 1.8 mm.; breadth of carapace, female 3.5 mm., male 2 mm.; length of abdomen, female 1.1 mm., male 1.2 mm.; width, female 0.6 mm., male 0.4 mm.

Color of alcoholic specimens uniform yellowish-white.

This *Argulus* was obtained from the gills of a species of *Fundulus* near New Orleans in 1862. Kröyer gave the fish the manuscript name *Fundulus limbatus*, which has been changed by Jordan and Gilbert to *F. ocellaris*. But both Kröyer and Thorell made a serious mistake in

reference to the parasite, the latter simply repeating the mistake of the former.

Krøyer describes and portrays what he calls a female of the species, which was the only specimen obtained. His figure shows at once that he has mistaken the sex and has really a male.

The length of the abdomen, the size of the testes, and the accessory copulatory organs on the posterior legs are unmistakable proofs of this. Thorell also states that both the male and female are known, which would manifestly be rather difficult from a single specimen. So far as known the present description and figure of the female are the first published.

That this is really the female of the species was very pleasantly confirmed after the description had been written by finding a male and female in the material sent for examination from the Ohio State University, which had been taken together from the same "minnow." The habitat of this species must now be extended to include the whole Atlantic coast, for the National Museum collection includes No. 6153, taken from among many fish at Waquoit, Connecticut; No. 6180, from Long Island Sound, and an unnumbered specimen from Woods Hole. (*fundulus*=generic name of its host.)

ARGULUS PUGETTENSIS Dana.

Plate XV.

Argulus pugettensis DANA, U. S. Exploring Expedition during the years 1838-1842, under the command of Charles Wilkes, U. S. Navy, XIII, Crustacea.—THORELL, Om tvenna Europeiska Argulider, etc., Öfvers. af Kongl. Vetensk.-Akad. Forhandlingar, 21st series, Stockholm, 1864.

Carapace elliptical, longer than wide, entirely covering the legs; posterior sinus rather narrow, two-fifths the length of the carapace. Abdomen large, broad elliptical, nearly half the length of the rest of the body; anal sinus broad triangular, cut fully to the center, lobes subacute; papillæ basal.

Sucking disks a little more than a quarter the width of the carapace and close together; posterior maxillipeds large and well armed; basal plate broadly wedge-shaped, teeth short, blunt, and far apart. Antennæ medium size, but very poorly armed. Swimming legs short, just reaching the edge of the carapace, furnished with flagella; lobes on the posterior pair small and scarcely projecting. Oviduct papillæ small.

Color, yellowish white in alcoholic specimens.

Length, 17.3 mm.; length of carapace, 12.8 mm.; width of carapace, 10 mm.; breadth of abdomen, 4 mm.; length, 5.3 mm. Male unknown.

Habitat.—From the shores of Puget Sound. Host unknown. (*Pugettensis*=from the name of its habitat.)

ARGULUS LEPIDOSTEI Kellicott.

Plate XVI.

Argulus lepidostei KELLICOTT, description of a new species of Argulus, Bull. Buffalo Soc. Nat. Sci., III, 1877.

Carapace elliptical, longer than wide; posterior sinus less than one-third the length of the carapace, wider than deep.

Abdomen broad ovate, more than one-third the length of the rest of the body, as wide as long; anal sinus broad triangular, cut half the length of the abdomen; papilla lateral, near the tips of the acute lobes. Sucking disks medium size and placed well forward; posterior maxillipeds rather small but stout and well armed on their ventral surface, their basal joint wider than that of the swimming legs; basal plate narrow, abruptly triangular posteriorly; teeth long, narrow, and very sharp.

First antennae rather weak, having two slender hooks, but only a single very small spine; second antennae larger and better armed. Swimming legs reaching beyond the edge of the carapace; lobes on the basal joints of the posterior legs enormous, boot-shaped, reaching beyond the edge of the abdomen.

Flagella present; a long slender papilla on either side of the opening of the oviduct. In the male the abdomen is considerably lengthened, with a rounded lobe on either side at its base; in addition to the regular accessory copulatory organs, the basal joint of the second legs is prolonged backward into a wide flap, reaching beyond the third legs, and there is a rounded knob on the anterior surface of the second joint of the third legs at its distal end. Eyes very small, brownish in color.

Color a light yellowish green, with the upper part of the body blotched and streaked with violet brown.

Length, 6.2 mm.; length of carapace, 3.75 mm.; breadth of carapace, 3.5 mm.; length of abdomen, 1.75 mm.; breadth, 1.7 mm. Male about two-thirds this size.

This species was found parasitic on *Lepidosteus osseus* Linnaeus, in the Niagara River, at Buffalo, in September, 1876, by D. S. Kellicott, who described and figured the female in the periodical above referred to. He had not at that time obtained any males.

Through the kindness of Prof. Henry Osborn, of the Ohio State University, at Columbus, where Professor Kellicott was stationed for many years, I have been enabled to examine personally Kellicott's types. I find among them a male which is here described for the first time. Professor Kellicott writes that—

The favorite place for the parasite to fasten is immediately back of the pectoral fins of its host. It often left the fish and swam about the tank, then returning fastened to any part presented, and crawled to its place near the pectoral fins. I have reason to believe that it may also occupy the gill cavities.

The types of this species are in the museum of the State University at Columbus, Ohio.

(*lepidosteus*=generic name of its host.)

ARGULUS STIZOSTETHII Kellicott.

Plate XVII.

Argulus stizostethii KELLICOTT, Amer. Jour. Micros., V, 1880, p. 53.

Carapace elliptical, much longer than wide; posterior sinus one-third the length of the carapace, twice as long as wide.

Abdomen long and narrow with parallel sides, one-half the length of the rest of the body, twice as long as wide; anal sinus cut beyond the center, narrow and slit-like toward the base, but flaring widely toward the tip; lobes acute; papillæ basal.

Cephalic area projecting considerably anteriorly. Sucking disks large, more than one-quarter the width of the carapace; posterior maxillipeds large and stout, their ventral surface thickly covered with setæ; basal plate large, triangular, and armed with stout sharp teeth. Antennæ large and well armed, median spine at the base of the second pair particularly stout. Swimming legs reaching far beyond the edge of the carapace; lobes on the basal joints of the posterior legs small and conical. Flagella present; small papillæ at the opening of the oviduct. Chitin rings in the lateral lobes of the carapace fused into one whose anterior end is about the normal size, while the posterior part is much narrowed, giving the whole ring a club-shaped appearance.

In the male the distal joint of the basipod of the second pair of swimming legs carries upon its ventral surface a large fleshy plate or lamella which projects backward, outward, and inward beyond the respective margins of the joint, and whose surface is covered with small sharp spines. There are also the usual capsule and peg on the third and fourth legs, respectively, while the lobe on the basal joint of the posterior legs is smaller than in the female. The carapace is shorter than in the female, barely covering the second swimming legs; the abdomen is relatively much longer and narrower, and in Kellicott's figure it is represented as fringed with setæ.

Length, 6.6 mm.; length of carapace, 4.2 mm.; breadth of carapace, 3.1 mm.; length of abdomen, 2 mm.; breadth, 1.1 mm.

These are the measurements of the specimens at my disposal, but Kellicott says that the females reach a size of 0.55 inch, which would be more than twice the above measurements. The males are about three-quarters as large.

Color.—Males and immature females are nearly colorless, with the sexual organs brown; mature females have the carapace, legs, and abdomen pale pea-green. The upper side of the thorax is darkened by the usual pigment spots, while the under side is white from the ripening eggs. "There is a light line along the dorsum."

Habitat.—Found on the blue pike, *Stizostethium salmoneum* Jordan, in the Niagara River at Buffalo; named from its host.

Kellicott verifies the statement of the local fishermen that during midsummer when the water is warm this blue pike "gets too lazy to take food; that it then gets poor and, through its inertness, becomes infested with lice." They are usually found on the top of the fish's head, often "huddled together in heaps, so the knife may remove a number at once." They occur also on the fins, but have never been found in the mouth cavity. Kellicott's paper descriptive of this species could not be found till just before this article went to the printer, but the author was gratified to find in it observations confirmatory of several of the habits of Argulids recorded here:

When put into my aquarium with a small specimen of *Lepidosteus osseus* and some minnows, they shortly located on them, fastening as before to the head and fins of the gar-pike, but to any part of the minnows; these latter soon die, killed apparently by the Argulus (p. 652).

At first these fish pursued and caught them, "but would eject them with a suddenness and a queer expression of frustration that was most amusing" (p. 647).

The gar even recoiled "in evident fear from one seen approaching." The removal of the scales from portions of the body surface in the fish that died, as noted by Kellicott, is readily explained by the fact already mentioned (p. 650) that the Argulids burrow in under the scales to find a place where the skin is soft enough for their stings to penetrate.

Through the kindness of Mr. William E. Kellicott, son of Prof. D. S. Kellicott, the author obtained a mounted specimen of this species for examination, and others were found in the material so generously sent from the Ohio State University.

From these and from Professor Kellicott's own description, which was found at the last moment through the aid of his son, the above facts have been drawn.

The fused chitin rings and the elongated abdomen are distinguishing characteristics of this species.

ARGULUS NIGER, new species.

Plate XVIII.

Carapace elliptical, longer than wide; antero-lateral sinuses sharp, but not deep; posterior sinus narrow and half the length of the carapace. The entire body and half the abdomen covered by the carapace lobes, which overlap across the back of the thorax. Abdomen broadly ovate, one-third the length of the rest of the body, the sides strongly rounded; anal sinus narrow, cut two-thirds the length of the abdomen, lobes rounded-acute; papillae basal. Sucking disks very large and far forward, one-fourth the width of the carapace; posterior maxillipeds

not large but stout, with a swollen terminal joint furnished with a pair of forceps-like hooks; basal plate triangular, teeth broad and blunt. Median spines between these maxillipeds with papillated plates at their bases. Antennæ medium sized and well armed with wide blunt spines. Swimming legs hardly reaching the edge of the carapace; lobes on the posterior ones very small. Flagella present; papillæ at the oviduct opening reduced to mere pimples. Color of alcoholic specimens a uniform dark brownish black on the dorsal surface, lighter below, with a narrow edge of yellow around the carapace, and yellowish areas around the eyes and brain.

Both surfaces of the abdomen are brownish yellow covered with small black spots, more numerous on the dorsal than on the ventral side.

Length, 14 mm.; length of carapace, 11 mm.; breadth of carapace, 9 mm.; length of abdomen, 4 mm.; breadth, 3.25 mm.; breadth of sucking disks, 2.25 mm. Male unknown.

Two specimens, both females, were obtained by the U. S. Fish Commission steamer *Albatross* at Portland, Oregon, October 2, 1889. Name of host not given. No number.

(*niger* = black.)

ARGULUS MACULOSUS, new species.

Plate XIX; Plate XXVI, fig. 82.

Carapace orbicular, length about the same as the width; posterior sinus reaching one-third the length of the carapace, wide at the base but posteriorly the lobes approach until they almost touch; antero-lateral sinus well defined.

Abdomen bluntly triangular, one-third the length of the rest of the body, a trifle wider than long; anal sinus broad triangular, reaching one-quarter the length of the abdomen; papillæ lateral, near the tips of the well-rounded lobes.

Sucking disks of medium size, placed rather near together; posterior maxillipeds small; basal plate rectangular, with three sharp teeth; ventral surface not much roughened.

Antennæ large, the anterior ones without any hook on their front edge; the basal spines large, and the one on the posterior antenna reinforced by a second as large as itself. These antennæ are widely separated anteriorly and approach each other posteriorly, so that this heavy armature of basal spines makes a conspicuous V of dark-colored chitin in front of the sucking disks.

Swimming legs reaching beyond the edge of the carapace; lobes on the posterior pair large, boot-shaped, reaching beyond the edge of the abdomen. Flagella present; papillæ at the opening of the oviduct long and narrow. Male about one-quarter smaller than the female, its abdomen of approximately the same shape. Beside the

regular peg and semen vesicle this species shows a number of protuberances on the legs of the male; the basal joint of the second pair has a rounded knob on the anterior surface next the body, and on the posterior surface at the distal end another rounded knob, and outside of this a long, finger-like projection. Both basal joints of the third pair have conical projections extending diagonally outward from their distal ends, that on the first joint being anterior and on the second joint posterior. The second joint of the last pair of legs also has a rounded knob on its posterior surface, and the peg on this joint is a spherical ball.

The posterior chitin ring in the carapace lobes is very broad, and its anterior end is slightly concave and extends diagonally outward and forward from near the base of the first pair of legs. Into the concavity fits the very much smaller anterior ring, so that the two form a symmetrical outline.

Color of alcoholic specimens a yellowish white, thickly spotted with brown over the entire dorsal surface and on the ventral surface of the abdomen, whence the name *maculosus*, spotted.

Length, 9.8 mm; length of carapace, 7.8 mm.; breadth of carapace, 7.9 mm; length of abdomen, 2 mm; breadth, 2.1 mm. Male about two-thirds this size.

The National Museum collection contains two lots of this species, one consisting of 14 specimens, 11 females and 3 males, unlabeled, the other a single female taken by Fred Mather from *Esox nobilior* Thompson, at Clayton, New York, and numbered 12226. This identifies it as a fresh-water species, which is also indicated by its close resemblance in many particulars to the two following species. In all probability it can be found upon the muscalonge elsewhere.

ARGULUS VERSICOLOR, new species.

Plate XX; Plate XXVI, fig. 83.

Carapace orbicular, about as wide as long; posterior sinus one-third the length of the carapace, twice as long as wide.

Abdomen ovate, three-sevenths the length of the rest of the body, longer than wide; anal sinus very narrow and slit like, only reaching one-sixth the length of the abdomen; papillæ subterminal. Sucking disks medium size, very symmetrically placed far apart, near the anterior edge of the carapace; posterior maxillipeds also medium size, well armed; basal plate somewhat wedge-shaped, with long and blunt teeth.

Antennæ large, long, and armed with powerful hooks and very long sharp spines, those at the base of the second antennæ reenforced by other smaller ones. Proboscis long and wide, sting narrow and very sharp. Swimming legs reaching far beyond the edge of the carapace,

and hence very long; the lobes on the posterior pair medium size, boot-shaped, reaching just to the edge of the abdomen. Flagella present; papillæ at the oviduct opening of good size and thickset.

Larger chitin ring in the carapace lobes extending forward opposite the base of the posterior maxillipeds, concave on its inner surface at the anterior end, and into this concavity the other very much smaller ring fits. This leaves the front of the carapace clear, unlike the other species.

In the male the second legs have a large conical projection on their posterior surface at the outer end of the basal joint.

There is a similar much smaller one in a corresponding position on the third legs, and these legs also have a rounded knob on the anterior surface of the second joint at the end next the body. The regular lobes on the basal joints of the last legs are longer and more slender than in the female, and are separated from the joint itself at the heel as well as at the toe.

This is a very clean-looking Argulus, and by far the most beautiful of any American species. It is a veritable Joseph among its brethren in the colors of its coat. The chitin framework and the spines on the ventral surface are a clear orange, the longitudinal ribs of the carapace having the orange bordered by yellow-green. The digestive tube is a deep wine red anteriorly, fading into yellow-green in the abdomen.

The testes and semen receptacles are a still deeper red, almost purple. The ground color of the body is a yellow-green, this color forming a wide border around the edge of the carapace and extending inward diagonally as a wide band on either side from the edge just behind the sucking disks to the base of the posterior sinus.

From the center of these diagonal bands another narrower band of the same color extends backward parallel with the edge of the carapace to near the posterior border of the lobes. At about their center these last bands are joined with the border along the edge by radial bands. In addition to these bands there are areas of the same color just outside the sucking disks and a large one in either lobe opposite the base of the first swimming legs.

The rest of the surface is filled in with orange-yellow of various shades, the posterior part of the lobes being tinged with brown, while over the side branches of the stomach it takes more or less of a reddish hue from the stomach contents. As may well be imagined, the whole presents a beautiful variegated appearance, whence the name given to the species. But the most wonderful thing about these beautiful colors is their permanency. They are "fast" colors in the fullest sense of the word, for they defy any preservative so far tried. Chrome-acetic and corrosive-acetic, Perenyi's and platinum chloride have no effect upon them, and after preservation in these solutions they have been kept in alcohol for over a year with so little change of

color that they can hardly be distinguished from fresh specimens, save for their greater opacity.

This species was first found by the author upon some common pickereel (*Lucius reticulatus* Le Sueur) caught through the ice at Powdermill Pond, Warren, Massachusetts. They have since been found on the same fish in Wickaboag and Podunk ponds, Brookfield; in Lake Lashaway, between Brookfield and Spencer; in Ashley Ponds, Holyoke; and in Congamon Ponds, Southwick, all in Massachusetts.

In fact, they have not been looked for in a single pond where they have not been found, and in all probability they infest this fish more or less throughout its habitat.

They can be distinguished from all other species at a glance by their brilliant coloration.

Length, 6 mm.; length of carapace, 4.4 mm.; breadth of carapace, 4.9 mm.; length of abdomen, 1.6 mm.; width, 1.6 mm.

(*versicolor* = variegated.)

ARGULUS AMERICANUS, new species.

Plate XXI; Plate XXVI, figs. 84-86.

Carapace obovate, as wide as long; posterior sinus narrow, extending one-third the length of the carapace, quite square at the base, but the sides converge quickly and the carapace lobes overlap considerably at their tips. Abdomen broadly triangular, one-half wider than long; anal sinus broadly triangular; papillæ subterminal. Sucking disks small, one-sixth the width of the carapace; posterior maxillipeds also rather small, but well armed; basal plate narrow, triangular, with wide squarely truncated plates on its posterior border in place of teeth, thus resembling *versicolor* and *catostomi*.

Antennæ rather small but furnished with strong hooks and spines; two spines instead of one at the bases of the posterior pair. Swimming legs long and very slender; lobes on the posterior pair very large, boot-shaped, with a distinct heel.

In the male, beside the regular copulatory organs, there are very long projections on the basal joints of the second and third legs at the distal ends. Those on the second legs are conical and on the posterior surface, those on the third legs are flattened, club-shaped, and on the anterior surface.

There are also smaller projections on these same joints opposite the large ones, and a rounded knob on the anterior surface of the second joint of the third legs. The abdomen in the male is scarcely elongated at all.

Flagella present; papillæ at the oviduct opening long and stout. Chitin rings in the carapace lobes similar to those in the last two species, but not extending quite as far forward. To compensate for the mediocre size of the two pairs of maxillipeds, we find the ventral sur-

face of the carapace thickly covered, over its anterior half, with large, sharp spines.

These spines are found on every species in greater or less abundance, but they are especially large and prominent on *americanus*. The color is a pale brownish white, sparsely covered on the ventral and dorsal surfaces with small pigment spots of a slightly darker hue. When alive this species is particularly transparent, and shows the side ramifications of the stomach very plainly. (See photograph, fig. 84.) This is one of our most typical American fresh-water species. The American continent, with the accession of the species here added, resumes once more the old position accorded it by Kroyer and Thorell as the proper habitat of the genus *Argulus*; and, lastly, the only host upon which this particular species has thus far been found is a genus of fish exclusively American (*Amia*). These reasons have suggested the specific name *americanus* as appropriate.

Length 10 mm.; length of carapace 8 mm.; breadth of carapace 8 mm.; length of abdomen 2.5 mm.; breadth 4 mm.

This species infests *Amia calva* Linnaeus in our Great Lakes region to such an extent as to become a nuisance when the fish are kept in aquaria. About 100 specimens were sent to the author by Prof. Jacob Reighard from Ann Arbor, Michigan, who wrote that he had been obliged to have the *Amia* cleaned to rid them of these pests. He also kindly sent the excellent photographs of the animal as an opaque object which show very clearly its specific characteristics. A dozen of these animals were sent in a mailing case from Ann Arbor to Westfield, Massachusetts, and every one was alive when received and lived for about a week afterwards.

An effort will be made in the near future to obtain ripe females in this way and follow the development of the species.

This concludes the North American species so far found, just half the entire genus, while of the other half four out of the thirteen species belong in Central or South America, leaving but nine species from all other localities combined.

It is well to recall again in this connection that the present is the first attempt to collect all the American species and must therefore be incomplete. By the time anything like as much work has been done in America as in Europe we may confidently expect that the preponderance of American species will be even greater than now.

Of the thirteen North American species here presented the location of the type of *pugettensis* is unknown, if indeed it has not been lost; the types of *lepidostei* and *stizostethii* are in the museum of the Ohio State University, while the types of the other ten species are in the National Museum. Five species are described for the first time; two others are removed from the doubtful list and the missing sex supplied, while the males of five out of the remaining six species are here first

distinguished. The non-American species of the family will be treated very briefly and from a purely systematic standpoint, after first describing the four from Central and South America.

ARGULUS NATTERERI Kollar.

Plate XXII, fig. 63.

Argulus nattereri HELLER, Beiträge zur Kenntniss der Siphonostomen. Sitzungsber. d. kais. Akad. d. Wissensch., Math.-naturwissensch. Cl., XXV, 1857.—KRÖYER, Bidrag til Kundskab om Snyltekrebsene. Naturhist. Tidskr., 3die Række, 2 Bind, 1863.—THORELL, Om tvenna Europeiske Argulider, etc. Öfvers. af Kongl.-Vetensk. Akad. Forhandlingar, 21st series, Stockholm, 1864.

Carapace orbicular, wider than long; posterior sinus narrow, reaching nearly half the length of the carapace.

Abdomen relatively the smallest of any species, not more than one-tenth the rest of the body, wider than long; anal sinus narrow, cut scarcely to the center; papillæ basal.

Sucking disks large, placed well back in the carapace, very close together, equaling about one-fourth the width of the carapace; posterior maxillipeds small and weak; basal plate narrow triangular with an abrupt angle near its center; teeth long and sharp with an accessory spur at the base of the outer one.

Antennæ large and well armed. Swimming legs very short, none of them reaching the edge of the carapace; lobes on both joints of the posterior ones flap-like and covered with setæ. Flagella present; no papillæ at the opening of the oviduct.

Length 12 mm.; length of carapace 11.5 mm.; breadth of carapace 13 mm.; length of abdomen 1.2 mm.; breadth 2 mm. Male unknown.

Color grayish white; skin covered with warts and spines on the dorsal surface. Two dark oblique spots on the abdomen.

Habitat.—Brazil, South America, on the skin and in the gill cavity of *Salmo* (*Hydrocyon*) *brevidens* Cuvier.

(Named for Johann Natterer, who obtained these Brazilian Arguli together with the specimens of the genus *Dolops*.)

ARGULUS SALMINI Kroyer.

Plate XXII, fig 64.

Argulus salmini KRÖYER, Bidrag til Kundskab om Snyltekrebsene. Naturhist. Tidskr., 3die Række, 2 Bind, 1863.—THORELL, Om tvenna Europeiske Argulider, etc. Öfvers. af Kongl. Vetensk.-Akad. Forhandlingar, 21st series, Stockholm, 1864.

Carapace orbicular, wider than long; posterior sinus wide, one-fourth the length of the carapace, cephalic area prominent.

Abdomen very small, about one-sixth the rest of the body, wider than long; anal sinus narrow, not cut to the center, lobes broadly rounded; papillæ basal.

Sucking disks very large, placed well forward and so close together that they almost touch, about one-third the width of the carapace; posterior maxillipeds correspondingly small; basal plate rectangular and armed with short blunt teeth.

Antennæ of medium size and well armed. Swimming legs not reaching the edge of the carapace; lobes on the posterior ones small, boot shaped. Flagella present but no papillæ at the oviduct opening. Male longer and much narrower than the female, particularly in the abdomen; the carapace also in the male overlaps the abdomen, while in the female it barely covers the third legs.

Color a light liver-brown with a narrow dark margin anteriorly on the upper surface of the carapace and a small dark spot at the base of the anal sinus. The grooves which separate the cephalic from the lateral areas are darker and more yellow in color than the rest of the integument. The male lacks the dark anterior margin of the carapace and the dark spot at the base of the anal sinus.

Length 13 mm.; length of carapace 10.4 mm.; breadth of carapace 10.6 mm.; length of abdomen 2.5 mm.; breadth 2.6 mm.

Habitat.—Brazil, South America, in the gill cavity of *Salmo*. (*salmini*, from generic name of host.)

ARGULUS CHROMIDIS Kröyer.

Plate XXII, fig. 62.

Argulus chromidis KRÖYER, Bidrag til Kundskab om Snyltekrebsene, Naturhist. Tidskr. 3die Række, 2 Bind, 1863.—THORELL, Om tvenna Europeiske Argulider, etc., (Eftvers. af Kongl. Vetensk.-Akad. Forhandlingar, 21st series, Stockholm, 1864.

Carapace obovate, longer than wide, scarcely reaching the third legs; posterior sinus so wide as to carry the lobes away from the thorax and leave a clear space between, and reaching but a quarter the length of the carapace.

Abdomen one-fourth the length of the rest of the body, about as wide as long; anal sinus wide, well rounded, reaching a quarter the length of the abdomen; papillæ basal.

Sucking disks small, about one-seventh the width of the carapace; posterior maxillipeds small, basal plate rectangular, with short, blunt teeth, the central one sharper than the others. Flagella present.

The eggs occupy not merely the trunk, but nearly the whole shield (Kröyer).

Length 6 mm.; length of carapace 4.1 mm.; breadth of carapace 4 mm.; length of abdomen 1.2 mm.; breadth 1.1 mm. Male unknown.

Color a clear yellowish-white, relieved by the dark coffee-brown egg masses.

Habitat.—Nicaragua, Central America, in the gill cavity of a species of *Chromis* taken from Lake Nicaragua.

(*chromidis* from generic name of host.)

ARGULUS ELONGATUS Heller.

Plate XXII, fig. 61.

Argulus elongatus HELLER, Beiträge zur Kenntniss der Siphonostomen. Sitzungsber. d. kais. Akad. d. Wissensch., Math.-naturwissensch. Cl., XXV, 1857.—TRORELL, Om tvenna Europeiska Argulider, etc., Öfvers. af Kongl. Vetensk.-Akad. Forhandlingar, 21st series, Stockholm, 1864.

Carapace very short, triangular, wholly without lobes; no posterior sinus. Abdomen one-quarter the length of the rest of the body, longer than wide; anal sinus broad triangular, cut almost to the very base, lobes divergent, acuminate-lanceolate; papillæ basal. Sucking disks medium size, placed well forward; posterior maxillipeds good size; basal plate without teeth but well armed otherwise. Antennæ of normal size and armament. As there are no carapace lobes the swimming legs are left wholly uncovered. No data as to flagella or oviduct papillæ, but inasmuch as Heller has been careful to put in the flagella in the other species he has illustrated, the absence of them in his figure of *elongatus* indicates that he could not find any. Color a yellowish white, very darkly pigmented and speckled; bases of the swimming legs also with circular black spots.

Length 10 mm.; length of carapace 4.3 mm.; breadth of carapace 6 mm.; length of abdomen 2 mm.; breadth 1.9 mm. Male unknown.

The abrupt truncation of the carapace distinguishes this species at once from all others.

Habitat.—Brazil. Host unknown.

(*Elongatus* = alludes to the elongated appearance of the body, due to the absence of lobes on the carapace—i. e., the elongation is apparent not real.)

ARGULUS FOLIACEUS Linnæus.

Plate XXIV, fig. 69.

Pou des Poissons BALDNER'S manuscript, 1666.

Monoculus cauda foliacea plana LOEFLING, 1750.

Pou de Gasteroste, Pou de la carpe BAKER, 1753.

Monoculus foliaceus LINNÆUS, 1758 and 1761.

Monoculus piscinus LINNÆUS, 1761.

Binoculus gasterosteus GEOFFROY-SAINT HILAIRE, 1762.

Insectum aquaticum LEDERMÜLLER, 1764.

Argulus charon MÜLLER, 1785.

Argulus delphinus MÜLLER, 1785.

Monoculus argulus FABRICIUS, 1792-1794.

Monoculus gyrini CUVIER, 1798.

Ozolus gasterostei LATREILLE, 1802.

Argulus foliaceus JURINE, 1806. [This name retained by the various authors given in the historical part, which see.]

Carapace elliptical, longer than wide; posterior sinus narrow, extending two-fifths the length of the carapace.

Abdomen one-fourth the length of the rest of the body, about as

wide as long; anal sinus broad, well rounded, cut nearly to the center; papillæ basal. Sucking disks small, one-sixth the width of the carapace, placed well forward and far apart; posterior maxillipeds large, well armed; basal plate narrowed anteriorly, triangular posteriorly, with three sharp teeth.

Antennæ normal. Swimming legs reaching far beyond the edge of the carapace; lobes on the posterior pair very small, evenly rounded. Flagella present, but no oviduct papillæ in the female. Abdomen in the male considerably elongated, but no copulatory organs except the regular peg and semen vesicle. Color a light green, becoming yellowish where the carapace is thickened.

Length 6-7 mm.; length of carapace 4.2-5 mm.; breadth of carapace 3.5 mm.; length of abdomen 2-2.5 mm.; breadth 1.35 mm.

Male about two-thirds this size; abdomen considerably elongated; anal sinus triangular and cut more deeply.

Habitat.—In fresh water almost all over Europe, both on the external skin and in the branchial cavity of fish, including several species of *Gasterosteus*, *Cyprinus carpio* Linnæus, *Abramis brama* Cuvier, *Leuciscus rutilus* Linnæus, *Tinca vulgaris* Cuvier, *Esox lucius* Linnæus, *Percu fluviatilis* Rondelet, *Salmo trutta* Linnæus, and on the tadpoles of *Rana*.

ARGULUS PURPUREUS Risso.

Plate XXIII, fig. 65.

Binoculus bicornutus RISSO, 1816.

Agenor purpureus RISSO, 1826.

Argulus purpureus THORELL, 1864.

Carapace elliptical, much longer than broad, with the sides approximately parallel; posterior sinus narrow, extending fully half the length of the carapace; antero-lateral sinuses deep.

Abdomen orbicular, a little longer than wide, entirely covered by the carapace; anal sinus narrow and slit like, extending to the center of the abdomen; papillæ basal; lobes acuminate orbicular. Sucking disks small, one-fifth the width of the carapace, close together; posterior maxillipeds large, well armed; basal plate rectangular, without any central rough area; teeth sharp.

Antennæ strong, well armed. Swimming legs short, slender, scarcely reaching beyond the carapace, lacking flagella; lobes on the posterior pair narrow and long. No oviduct papillæ. Eyes small and semilunar.

This is the only species except *versicolor* which is at all highly colored. Carapace pale blue-green, sparsely spotted with white; three violet bands in either lobe, which widen and fuse anteriorly, while the two inner bands are connected by a narrow line of the same color. Pigment spots on the ovary violet and so arranged as to leave a median line of pure white.

Appendages and ventral surface yellowish brown, deeper at the center; endopodites and exopodites glass-green.

Length 18 mm.; length of carapace 18 mm.; breadth of carapace 10 mm.; length of abdomen 6 mm.; breadth 6 mm. Male about one-third smaller, with only the regular peg and semen vesicle for copulatory organs.

Habitat.—Mediterranean at Nice on *Caranx lina* Geoffroy, by Risso, and on *Pagellus erythrinus* Linnaeus, by Thorell. The specimens found by Risso were usually attached to the base of the pectoral fin, and the single specimen found by Thorell was similarly placed.

All Risso's specimens were males, while Thorell's was fortunately a female. The latter seems to think that this species might be regarded as the type of a new genus for which he would propose the name *Agenor* Risso. But the only reasons for this which he can bring forward are the unusual development of the carapace, the absence of flagella, the presence of two lamellæ on the last thoracic segment, and certain slight modifications in the mouth parts. It is very evident that none of these have any generic value.

The shape and markings of *A. giganteus*, as given in the figure by Lucas (1845) are almost exactly the same as those of the present species as figured by Thorell. The color also (yellow finely dotted and traversed lengthwise on either side with a red-brown line) is what might fairly be expected in a *dried* specimen, the only one ever obtained. And then this single specimen was found near Algeria, in the Mediterranean, which is not so very far from Nice. For these reasons and because the specimen was dried, and neither adequately described nor figured it seems best to consider it another specimen of *A. purpureus* until some better data can be obtained.

(*purpureus*=purple, from the color).

ARGULUS COREGONI Thorell.

Plate XXIV, figs. 70, 71.

Argulus coregoni THORELL, 1864.

Carapace orbicular, a little longer than wide in the female, a little wider than long in the male; posterior sinus about one-third the length of the carapace, as wide as long in the female, narrower in the male and converging so that the tips of the lobes overlap. Abdomen long, elliptical, two-fifths the length of the rest of the body, cut fully to the center with lanceolate-acuminate lobes; papillæ basal.

Sucking disks small, one-sixth the width of the carapace and rather widely separated; posterior maxillipeds large, well armed; basal plate rectangular, teeth stout and sharp.

Antennæ medium size and well armed. Swimming legs reaching beyond the carapace in the female, entirely covered in the male; lobes on the posterior pair very small and well rounded.

In the male there are practically no lobes at all, but the copulatory organs are well developed. The second joint of the second pair of legs has on its posterior surface three rounded protuberances, two of which are ventral, one near the base of the joint and one near the tip, while the third one is dorsal and directly over the first at the base of the joint. The flagella of these legs are longer than those of the first pair.

The third legs carry, on the anterior side of the basal joint, a small rounded knob drawn out at the tip into a soft tooth; the second joint carries a similar protuberance, curved at the tip so that it bends over and offsets the tooth of the basal joint like the fingers of a pair of forceps. The regular peg on the fourth legs appears to be double instead of single.

At the base of the abdomen on either side in the female is a small ovate scale attached to the last segment of the thorax; this is lacking in the male, and yet is one of the things which Thorell proposed for generic differences in *A. purpureus*.

Color of alcoholic specimens green, whitish, or tawny. Length 13 mm.; length of carapace 8.6 mm.; width of carapace 8.5 mm.; length of abdomen 3.9 mm.; breadth 2.7 mm.; male about 0.8 this size.

Habitat.—In the larger lakes of central and northern Sweden; in Storsjon and other lakes of Jemtland on *Coregonus lavaretus* Linnaeus, and *Thymallus vulgaris* Nilsson. In the salmon-lakes of Dalsland and in the Vettern on *Salmo trutta* Linnaeus. Found on the external skin instead of the branchial cavity.

Dr. Nystrom in his Observations on the River-fauna of Jemtland (1863) gives a fact in reference to this species which is of particular interest in its bearing on the general question of the relation between these parasites and their hosts. He says: "An unusually large species of *Argulus* (referring to *A. coregoni*) fastens itself at certain times in summer, in large numbers, on the Gwyniad (*Coregonus*), and also, though less readily, on the Grayling. Almost every fish has, during this time, one or several of these bloodsuckers on its body, which bite it till the belly is quite drained of blood. The fishes then hurry in crowds to certain parts of the lake, where probably the currents are colder, and fall in large quantities into the nets which are there spread for them. This fishing lasts but a short time, perhaps two days only, but produces during that time in some localities several tons of fish." (See the account of *catostomi* given on p. 651).

(*coregonus*=generic name of its most common host.)

ARGULUS MELITA Van Beneden.

Plate XXIII, fig. 66.

Argulus melita VAN BENEDEN, 1891.

Carapace elliptical; antero-lateral sinuses situated far back opposite the sucking disks and cut in very deeply, leaving the cephalic area

sharply marked off from the remainder of the carapace, and lunate or semielliptical in shape; posterior sinus broad triangular, less than a quarter the length of the carapace, wider than deep. Abdomen elliptical, two-fifths the length of the rest of the body; anal sinus broadly triangular, cut to the center; lobes acute and flaring at the tips; papillæ basal. Sucking disks large, one-quarter the width of the carapace, situated far back, and widely separated; posterior maxillipeds small and poorly armed; basal plate well rounded, with only two teeth. Antennæ large and well armed.

Swimming legs long, reaching far beyond the carapace; lobes on the posterior pair narrow sickle-shaped, much elongated.

Color a fleshy pink, ornamented with lines and bands of dark pigment; the latter include a broad longitudinal band between the eyes, an oval area in the center of each carapace lobe, the two areas connected by three transverse lines, and an oval area in the center of each lobe of the abdomen, connected anteriorly by a single transverse line.

Length 7 mm.; length of carapace 4.4 mm.; breadth of carapace 3 mm.; length of abdomen 2 mm.; breadth 1.3 mm. Male unknown.

Habitat.—From Senegal, in the Bay of Dakar, on a species of shark.

(*Melita* = the name of the yacht of M. Chevreux, who found the parasite and sent it to Van Beneden.)

ARGULUS DACTYLOPTERI Thorell.

Plate XXIII, figs. 67, 68.

Argulus dactylopteri THORELL, 1864.

Carapace elliptical; cephalic area projecting considerably beyond the outline of the remainder of the carapace, leaving ear-like appendages on either side. Those in the female are of medium size and are situated in front of the sinus; those in the male are very large and protrude posterior to the sinus, giving the anterior portion of the carapace a three-lobed appearance. Posterior sinus broadly triangular, about as wide as deep, leaving well-rounded lobes. Abdomen broadly triangular, about one-third the length of the rest of the body; anal sinus narrow, about one-third the length of the abdomen; lobes rounded acuminate; anal papillæ very minute and basal.

Sucking disks small, less than one-sixth the width of the carapace; posterior maxillipeds rather poorly armed; basal plate with minute teeth along its outer border in addition to the three on its posterior border. Antennæ with stout auxiliary spines in addition to the regular ones on the basal joints. Swimming legs without flagella; just reaching the margin in the female, extending beyond in the male.

Color grayish white in alcoholic specimens, the female with two violet bands along the dorsal surface of the thorax made up of small spots of the same color.

Length 7-8 mm.; length of carapace 5 mm.; breadth of carapace

5 mm.; length of abdomen 1.85 mm.; breadth 2.2 mm. Male about five-sevenths this size.

Habitat.—The East Indian Ocean in the branchial cavity of *Dactylopterus volitans* Linnaeus.

(*dactylopteri*, from its host.)

ARGULUS INDICUS Weber

Argulus indicus WEBER, 1892.

Female similar to *foliaceus*, ou. with a carapace wider than long and overlapping the abdomen. Abdomen about 0.25, wider than long, with a short, narrow sinus.

Swimming legs long; lobes of the last pair hatchet-shaped and half as long as the legs themselves; anterior pairs with flagella. No color given and the only figure one of the posterior legs.

Habitat, from the East Indian Archipelago. Host unknown. Single specimen a female.

(*Indicus*, of or belonging to India).

ARGULUS AFRICANUS Thiele.

Argulus africanus THIELE, 1901.

Female similar to *foliaceus* but with a broader shield; abdomen with shorter rounded lappets. Lobes on the posterior legs hatchet-shaped, as in *indicus*, but smaller; anterior antennæ stout. In the male the carapace and abdomen are longer and narrower than in the female. In addition to the regular peg and semen receptacle the second leg carries a stout papillary wart on the posterior side opposite the base of the exopodite of the third leg. The third leg itself is covered with numerous papillary warts, especially on its dorsal and anterior surfaces. The basal plate is small, oval, and pointed anteriorly. No color given; no figure published.

Length in both sexes 7 mm.; width in female 4.5 mm.; in male 4.

Habitat.—Numerous specimens from Langenburg on species of *Claria*, a female from Albert Edward Sea and a female from the Nile. (*Africanus*=of or belonging to Africa.)

ARGULUS JAPONICUS Thiele.

Argulus japonicus THIELE, 1901.

Female similar to *foliaceus*, but carapace more abruptly rounded posteriorly, broader, and somewhat narrowed anteriorly.

Swimming legs tolerably long; lobes of the last pair small and rounded. Abdomen terminating in two small rounded lobes, widely separated. Color brownish; no figure published.

Length of the single specimen 4 mm.; breadth 2.7 mm.

Habitat.—From Yeddo, Japan. Host unknown. Single specimen, a female.

(*Japonicus*=of or belonging to Japan.)

ARGULUS SCUTIFORMIS Thiele

Argulus scutiformis THIELE, 1901.

The male has an oval shield which covers half the abdomen; anterolateral sinuses very deep. Anal sinus of abdomen very short, leaving short rounded lobes. Spines on the first antennæ reenforced. Posterior maxillipeds short and stout, with short sharp teeth; basal plate very large and covered with papillary warts. Swimming legs completely covered by the carapace; flagella on the second legs rudimentary.

No copulatory organs except the regular peg and semen receptacle. Color brownish; no figure published.

Length 12 mm.; width 8 mm. Female unknown.

Habitat.—The single specimen is in the Vienna Museum and came from Japan. Host unknown.

(*scutum*=shield, *forma*=shape.)

ARGULUS PHOXINI Leydig.

Plate XXVII, fig. 91.

Argulus phoxini LEYDIG, 1871.

Carapace orbicular, about as wide as long; anterolateral sinuses shallow. Grooves between the cephalic area and the lateral lobes well defined, separating the two sharply; lobes curved inward toward each other till they almost meet posteriorly. Ribs supporting the carapace well defined, the longitudinal ones forked at the anterior end as in *foliaceus*; abdomen elliptical, more than three-fifths the length of the rest of the body; anal sinus cut beyond the center; lobes acute and flaring at the tips; papillæ lateral, about one-fourth the distance from the base of the sinus.

Sucking disks small, less than 0.16, widely separated; rays composed of elliptical rods placed end to end. Posterior maxillipeds rather small but well armed; basal plate elliptical, thickly covered with spines.

Swimming legs reaching beyond the edge of the carapace; lobes on the posterior pair small and orbicular with no trace of a boot-shape. In the male the testes are very large, filling the entire basal portion of the abdomen. The peg is covered with long finger-like protuberances or papillæ, while the receptacle takes on a peculiar warty or knobbed appearance, due to numerous small protuberances scattered over its surface.

In addition to these there is on the anterior margin of the basipods of the third legs a pair of accessory organs consisting of a curved hook at the base of the terminal joint and a short papilla thickly covered with spines opposite the hook at the distal end of the second joint. On the posterior margin of the basal joint of the second legs is a knobbed protuberance somewhat similar to the receptacle in appearance.

Color.—Yellowish horn-color, with spots of brown pigment thickly scattered over the dorsal and ventral surfaces; spines and hooks brown.

Length, 8 mm.; length of carapace, 4.8 mm.; breadth of carapace, 5 mm.; length of abdomen, 3 mm.; breadth, 2 mm. Female unknown.

Habitat.—From Tübingen, on a species of dace or minnow, *Phoxinus lewis*.

(*phoxinus*=generic name of host.)

Genus CHONOPELTIS Thiele.

This genus differs from both *Argulus* and *Dolops* in the complete suppression of the first antennæ. The simple second antennæ are present, and are similar in all respects to those on the other two genera. This takes away entirely from the antennæ the acquired function of prehension, and leaves them in their original condition as tactile organs.

There is also an entire absence of spines on the ventral surface of the carapace, so that the animal must depend wholly on its maxillipeds for fastening itself to its host.

This genus resembles *Argulus* and is unlike *Dolops* in that the anterior maxillipeds are modified into sucking disks.

On the other hand, it resembles *Dolops* and is unlike *Argulus* in the complete suppression of the preoral sting.

The posterior maxillipeds and the swimming legs are similar to those of *Argulus*.

($\chi\acute{o}\nu\eta$ =a funnel, $\pi\acute{\epsilon}\lambda\tau\eta$ =shield.)

CHONOPELTIS INERMIS Thiele.

Chonopeltis inermis THIELE, 1901.

Cephalic area distinctly separated from the lateral areas by a tangential chitin ridge on either side, between which the antennæ are inserted. Abdomen with acuminate lobes; anal papillæ club-shaped and situated on the sides of the sinus near the base. Basipods of the swimming legs with a fringe of plumose setæ; only the first pair have flagella, and these are rudimentary; lobes on the posterior legs broad and short.

Carapace covering only the first two pairs of legs.

Color blue with numerous dark spots on the back of the thoracic segments. Length of the single specimen 6 mm.; width of the carapace 3.5 mm. Male unknown.

Habitat.—From the gill cavity of a species of *Chromis* at Wiedenhafen.

(*inermis*=unarmed.)

Genus DOLOPS Audouin.

This genus was first described by Audouin in 1837 and afterwards more in detail by Helier in 1857. It differs from both the other genera in the fact that the anterior maxillipeds are not modified into sucking disks, but terminate in strong, sickle-shaped hooks (fig. 73). It resembles *Argulus* and is unlike *Chonopeltis* in the presence of both pairs of antennæ and of spines on the ventral surface. On the other hand it is like *Chonopeltis* in the complete suppression of the preoral sting. The carapace is large, orbicular, or inversely egg-shaped, and in the species so far known it almost covers the legs. In two of the species, *longicauda* and *doradis*, the abdomen is very long and narrow and is cut clear to the base. In *kollari* it is orbicular and resembles closely that of *Argulus megalops* and *A. laticauda*, while in *gayi* it is more like that of *A. alosæ*.

The first antennæ lack the hook on the anterior margin which is present in most of the *Arguli*, and the spines on the basal joints of both pairs are much reduced in number (fig. 74).

The anterior maxillipeds, while not modified into sucking disks, are yet very unlike the posterior ones. They are short and stout; the basal joints are very wide and thick set, but the subsequent ones diminish rapidly in size, so that the terminal joint is only wide enough to receive the base of the large sickle-shaped hook. Opposed to the hook at its base is a short, cylindrical peg, the two fitting together much like the chela of a lobster or crab (fig. 73). The hooks on the two maxillipeds curve in toward each other, and when once driven into the flesh of the host by the powerful muscles within the basal joints they must afford a very secure hold. But it will evidently be quite a task to withdraw them, and one that will consume some time. Hence they are not at all suited for that scuttling motion so characteristic of *Argulus*, and *Dolops* must be a genus which can not move about freely over its host's body.

Again, the wound itself and the subsequent irritation caused by the insertion of these powerful hooks is amply sufficient to cause a strong flow of blood, and obviates the necessity of any sting. Consequently we find the mouth parts consisting of a short conical proboscis between the bases of these anterior maxillipeds, somewhat in front of its position in *Argulus*, and there is no trace of any preoral sting.

The proboscis is formed from the upper and under lips strengthened by a frame work of chitin rods similar to that already described, but there are no maxillæ.

The posterior maxillipeds have the basal plate armed with three teeth, but have no claw on the terminal joint (fig. 72). In its place the tip of the terminal joint is divided into two papillæ of unequal length. The inner, larger one is covered on its ventral surface with two rows of curved spines, four to seven in each row, while the shorter, outer papilla ends in a single row of four or more larger, sickle-

shaped spines. The swimming legs are the same as in *Argulus*, but the third pair have a smaller flagellum in addition to the fully developed ones on the first two pairs. The endopodite of the first pair is without joints. Both basal joints of the posterior pair are furnished with large flat flaps, which underlie the base of the abdomen. The testes of the male are divided longitudinally into narrow lobes, two in some species (*longicauda*, etc.), and three in others (*ranarum*, etc.), in each testis. The accessory copulatory organs in *longicauda* show the regular peg and semen receptacle, with the addition of large finger-like protuberances on the anterior border of the third legs.

In the female of *doralis* the papillæ on the ventral surface connected with the semen receptacles are long and finger-like, and seem to be destitute of spines.

The position of the anal papillæ is not given for any species except *ranarum*; *doralis* has a pair of very rudimentary papillæ at the opening of the oviduct, but in none of the other species are they mentioned.

After this paper had been placed in the printer's hands the U. S. National Museum secured from the Paris Museum specimens of both sexes of the species *Dolops reperta*, *doralis*, *ranarum*, and *bidentata*.

These were kindly placed in the author's hands for examination, and through them the facts relative to those species have been verified.

At the same time the author was fortunate enough to secure Bouvier's Memoir on the genus *Dolops* (1899²), from which the facts relative to the other species of the genus have been obtained.

Bouvier deals with external anatomy only, and makes no mention of the internal structure.

So far as could be determined from the preserved specimens just mentioned, the internal anatomy corresponds very closely with that in *Argulus*.

Nothing could be seen of the nervous system except the brain and here and there a peripheral nerve; but these were almost identical in shape and position with the corresponding portions of the nervous system in *Argulus*. There is a heart placed similarly to that in *Argulus*, with a short anterior aorta (Stuhlman), and the blood takes much the same course in circulation, save that in the abdomen the outgoing current passes backward along the margin and returns through the center, just the reverse of the course in *Argulus*.

The digestive system is practically the same as the one already described. Whether the reproductive organs are similar to those in *Argulus* could not be determined with certainty. The semen receptacles of the female are located in the same position in the abdomen, and there are two minute papillæ, one on either side, just posterior to the oviduct opening, where the hollow papillæ were found in *Argulus*, and in all probability these in *Dolops* are similar in function, if not in structure.

The ovary is also similar, being unsymmetrical and occupying the center of the ventral surface.

In the male the testes are much larger than in *Argulus*, but occupy the same position, while we find on the two posterior pairs of legs the accessory peg and semen receptacle as in the former genus.

The chief distinctions between the two genera, therefore, are confined to the anterior maxillipeds and the mouth parts, as given in the artificial key herewith presented.

DOLOPS LONGICAUDA Heller.

Plate XXV, fig. 76.

Gyropeltis longicauda HELLER, 1857.

Gyropeltis longicauda KRÖYER, 1863.

Gyropeltis longicauda THORELL, 1864.

Dolops longicauda BOUVIER, 1899.

Carapace orbicular, as broad as long; posterior sinus one-fifth the length of the carapace, as broad as long.

Abdomen very long and narrow, one and one-half times the length of the rest of the body; anal sinus broad triangular, cut clear to the base, leaving the lobes very narrow-acuminate and flaring at the tips. Anterior maxillipeds short with few joints, terminated by a stout hook; posterior maxillipeds stout; basal plate with three sharp teeth close together.

Swimming legs rather small; lobes on posterior pair large and wide. Each testis divided longitudinally into two lobes united at their bases; accessory copulatory organs consisting of two finger-like projections from the anterior surface of the basipods of the third pair of legs.

Flagella present. In the male the testes are two-lobed and there are lobes on the posterior border of the basal joints of the third legs in addition to the regular peg and capsule.

Color a dark ashy-gray, with a line of pigment around the edge of the carapace and along the inner border of the abdomen lobes. Length 28 mm.; length of carapace 12 mm.; width of carapace 12 mm.; length of abdomen 16 mm.; breadth of each lobe at the widest place 1.9 mm. Male about the same size.

Habitat.—In Brazil on the gills of *Hydrocyon* (*Salmo*) *brevidens*, Cuvier.

(*longa*=long, *cauda*=tail (abdomen).)

DOLOPS KOLLARI Heller.

Plate XXV, fig. 77.

Gyropeltis kollari HELLER, 1857.

Gyropeltis kollari KRÖYER, 1863.

Gyropeltis kollari THORELL, 1864.

Dolops kollari BOUVIER, 1899.

Carapace large, obcordate, covering all the legs and the base of the abdomen; posterior sinus shallow, one-seventh the length of the cara-

pace, as wide as deep. Abdomen broad elliptical, one-third the length of the rest of the body, as wide as long; anal sinus narrow, extending about one-third the length of the abdomen. Anterior maxillipeds long, stout, many jointed; posterior ones slender; basal plate very wide, teeth blunt and far apart, much resembling those of *A. catostomi* and *A. americanus*.

Antennæ as in *longicauda*. Swimming legs not reaching the edge of the carapace; flagella on the two anterior pairs; lobes on the posterior pair long, narrow, well rounded.

Teeth on the ventral surface of the carapace roughly arranged in transverse rows, those in the area between the antennæ much larger than along the margin. Color a grayish white, without the bands of pigment seen in *longicauda*.

Length, 12 mm.; length of carapace, 10 mm.; breadth of carapace, 9 mm.; length of abdomen, 3 mm.; width, 3 mm. Heller's figure, contains a pair of three-lobed testes in the abdomen, and therefore ought to be a male, contrary to the statement given by Thorell, although the posterior legs do not show any copulatory organs. Bouvier, in his thorough review of the species, does not even mention this fact. But he did examine Heller's type specimen, and distinctly states that only females are known.

Habitat.—In Brazil, host unknown. (*kollari* = to Vincenz Kollar, director of the museum from which Heller obtained his specimens.)

DOLOPS DORADIS Cornalia.

Plate XXV, fig 75.

Gyropeltis doradis CORNALIA, 1860.

Gyropeltis doradis THORELL, 1864.

Dolops doradis BOUVIER, 1899.

Carapace orbicular, a little wider than long; posterior sinus two-fifths the length of the carapace, wide and well rounded at the base, but the sides approach posteriorly until the lobes almost touch each other. Abdomen long and narrow, one-half the length of the rest of the body; anal sinus narrow, cut clear to the base, leaving very narrow acuminate lobes.

Anterior maxillipeds very wide at the base and so short as to have almost the outline of an equilateral triangle; posterior maxillipeds much longer; basal plate wide, with regular saw teeth close together. Antennæ long and slender; the first pair have no hook upon the anterior margin, but the lateral hooks are much longer than in other species and strongly curved.

Swimming legs reach a trifle beyond the edge of the carapace; the three anterior pairs furnished with flagella; lobes on the two basipod joints of the posterior pair large and broad.

Papillæ connected with the semen receptacles in the abdomen of the

female long and finger-like; papillæ at the opening of the oviduct small and rudimentary.

Color uniform gray or gray-white, spotted with black pigment arranged more or less regularly. Half a millimeter from the edge of the carapace runs a dark line, wide in the center of each side, narrower toward the anterior and posterior ends.

There are also two black triangles in the anterior portion of the carapace, one in front of each lateral eye, consisting of large spots connected at the apices by bands.

The males described by Bouvier are less pigmented than the females. The testes are two-lobed as in *longicanda*. In addition to the regular peg and capsule, there is also a rounded lobe and a long, pointed stylet on the posterior border of the basipod of the second legs, and two unequal papillæ on the anterior border of the basipod of the third legs.

Length, 22.5 mm.; length of carapace, 13 mm.; breadth of carapace, 11 mm.; length of abdomen, 7.5 mm.; width of lobes, 1.5 mm. Male smaller.

Habitat.—The two females described by Cornalia were found on the body of a cat-fish (*Doras niger* Valenciennes) which frequents the rivers of Central America.

(*doradis*—from generic name of host.)

In the *Annales de la Societe Entomologique de France*, sér. 1, VI (1837), Bulletin, p. 13, we find the following:

M. Audouin présente deux individus d'un crustacé singulier, qui a beaucoup d'analogie avec l'Argule foliacé de Jurine, mais qui en diffère surtout par l'absence de ventouses aux pattes antérieures, et par sa taille, qui dépasse un centimètre et demi.

Ce crustacé a été trouvé à Cayenne par M. Lacordaire; il est parasite sur un poisson nommé *Aymara*, dont la chair est très-estimée, et qui vit dans toutes les rivières. M. Audouin en donne la description et la regarde comme le type d'un nouveau genre, auquel il assigne le nom de *Dolops*. Il dédie cette espèce à M. Lacordaire.

Dolops Lacordairei. Ce nouveau genre sera décrit en détail et figuré.

As Thorell has pointed out, this "Dolops" is identical with Heller's *Gyropeltis*, or at least very closely related to it. The promised description was never published, but M. Geay has recently obtained from practically the same locality (Guiana instead of Brazil), and on exactly the same fish, the "Aymara," a species of *Dolops*, which Bouvier (1899¹) has decided is the same as Audouin's two specimens, and for which he gives the following description:

DOLOPS REPERTA Bouvier.

Plate XXVII, fig 87.

Gyropeltis reperta BOUVIER, 1899¹.

Dolops reperta BOUVIER, 1899².

Carapace suborbicular, somewhat narrowed anteriorly, nearly covering all the feet. Abdomen broad, triangular, widest at the center,

with well-rounded sides; anal sinus cut deeply, slit-like in shape, leaving blunt lobes.

Anal papillæ small and basal. Anterior maxillipeds with a fleshy lobe or papilla opposite the terminal claw; teeth at the base of the posterior maxillipeds narrow and triangular; those on the basal plate very blunt, but both kinds are enormous, compared with the size of the animal. Antennæ noticeable chiefly for the size of the terminal joint of the second pair, which is about two-thirds as large as the preceding joint.

Swimming legs just reaching the edge of the carapace. The spines covering the ventral surface of the carapace are very large in the frontal region between the antennæ and over the anterior submarginal area, but become smaller posteriorly. They are arranged in two or three irregular rows along the sides of the carapace.

In the males the testes are three-lobed, and there is a conical papilla on the anterior border of the basipod of the third legs. This species is much smaller than Audouin's, being only 7 instead of 15 mm. in length; no other dimensions given.

Color a uniform dark green, with three colorless areas anteriorly, one median and two lateral, the median one narrow oblong, extending forward from the brain to the marginal area of the carapace, the lateral ones triangular, one side parallel to the sides of the median area and the lateral eye in the posterior angle.

Habitat.—Guiana, on the fish called "Aymara."

(*reperita*=found again, i. e., Audouin's species rediscovered.)

DOLOPS STRIATA Bouvier.

Gyropeltis striata BOUVIER, 1899¹.

Dolops striata BOUVIER, 1899².

Carapace elliptical, a little longer than wide. Abdomen narrower than in the preceding species, triangular in shape, with well-rounded sides; anal sinus cut deeper than in *reperita*, leaving the lobes rather more pointed. Anal papillæ small and basal. The protuberance opposite the claw on the anterior maxillipeds is very small; the basal plate of the posterior maxillipeds has three truncated teeth, of which the outer one is much larger than the other two.

The two spines on the ventral surface between the bases of these maxillipeds and a little posterior to them are very large, as wide as they are long, and have a broad, squarely cut tip.

The swimming legs reach considerably beyond the edge of the carapace. The spines on the ventral surface are numerous in the region between the antennæ, and are arranged in distinct transverse lines. Back of the antennæ, in the lateral areas of the carapace, they are grouped in oblique lines, directed outward and backward. These spines wholly disappear opposite the anterior swimming legs, and there are none on the posterior portion of the ventral surface.

Length from 6 to 7 mm.; no other dimensions given. Color, green marbled with blue.

Habitat.—Guiana, from a species of *Anguilla*.

(*striata* = striped, in allusion to the lines on the ventral surface caused by the arrangement of the spines.)

DOLOPS BIDENTATA Bouvier.

Plate XXVII, fig. 88.

Gyropeltis bidentata BOUVIER, 1899.¹

Dolops bidentata BOUVIER, 1899.²

Carapace elliptical, rather large, but not covering the swimming legs. Abdomen broadly elliptical instead of triangular, with a deep anal fissure, which is slit-like in shape; lobes well rounded; anal papillæ small and basal.

Anterior maxillipeds have no protuberance opposite the terminal claw; the second maxillipeds have only two teeth on the posterior margin of the basal plate instead of three; the teeth between the bases of these maxillipeds are long and slender, but rather blunt. Both pairs of antennæ are slender and the anterior ones have no spine on their basal joints.

The spines on the ventral surface of the carapace are slender and about of a size in the region between the antennæ, but those extending backward in a row along the margin of the carapace are much smaller. In the male the testes are two-lobed and the accessory capulatory apparatus is quite complicated. The latter consists of two unequal lobes on the posterior border of the second basipod joint of the second legs, and a pair of very long and convoluted papillæ on the basal joints of the third and fourth legs. Those on the third legs are on the posterior border, those on the fourth legs on the anterior border. This species is very small compared with the preceding ones, being only 2 to 4 mm. in length. Color, a violet brown, due to pigment granules, which are arranged in sinuous lines or in a cobweb pattern.

Habitat.—Guiana on a species of *Anguilla*.

(*bidentata* = two-toothed, because it has only two teeth on the basal plate of the second maxillipeds.)

DOLOPS GEAYI Bouvier.

Plate XXV, fig. 78.

Gyropeltis geayi BOUVIER, 1897.

Dolops geayi BOUVIER, 1899.²

Carapace elliptical with a very even curve; not covering the posterior pairs of swimming legs; posterior sinus broad, well-rounded, about one-third the length of the carapace; lobes broad and well-rounded. Abdomen broadly triangular, cut almost to the base; anal sinus tri-

angular and very wide posteriorly, the tips of the acuminate lobes being so far apart that the sides of the abdomen are almost parallel. Anal papillæ of good size and basal. Anterior maxillipeds with an enormous terminal hook, strongly curved; the teeth on the basal plate of the second maxillipeds are small and very blunt.

Swimming legs all project beyond the edge of the carapace, which does not cover even the bases of the posterior pair. The flagella in this species are moderately developed and terminate in a sharp spine; the endopods and exopods are furnished with a double row of plumose setæ; lobes on the basal joints of the posterior legs of good size and boot-shaped.

In the male the testes are two-lobed, with a pair of spherical bodies on either side just anterior to the opening of the vas deferens, which Bouvier could not interpret.

Length of smaller male, 1.95 mm.; length of carapace, 1.29 mm.; width of carapace, 1.2 mm.; length of abdomen, 0.65 mm.; width, 0.55 mm. The larger male had a total length of 3 mm. The female was much smaller. These dimensions must of course be taken as those of rather small specimens.

Color a uniform gray-yellow without any markings.

Habitat.—The three specimens were obtained by M. Geay in the month of December between Apure and Arauca, Guiana, and were swimming freely at the surface of the water. (*Geayi* = to M. Geay.)

This finding of them swimming at the surface, in connection with their small size, might suggest that they were the young of some of the other species. This objection is to my mind answered fully by Bouvier when he says, first, that these specimens were sexually mature and therefore must possess all the characteristics of the adult even though they were still small in size. And then in the second place we have seen in the development of the only member of the whole family of Argulidæ whose complete history is known that the young do not become sexually mature till they are about one-quarter the size of the adult. This would mean that even if these were the young of some species the adults could not be anywhere as large as the great majority of the known species of this genus.

DOLOPS RANARUM, Stuhlmann.

Plate XXVII, figs. 89, 90.

Gyropeltis ranarum STUHLMANN, 1891.

Dolops ranarum BOUVIER, 1899.²

Carapace somewhat ovate, just reaching the base of the abdomen; posterior sinus rather narrow and about one-third the length of the carapace; lobes well rounded and approaching each other somewhat posteriorly. Abdomen long (about 0.5) and narrow, widest at the center, cut for two-thirds its length. Anal sinus peculiar in shape

owing to the direction of its sides; the base is rather broad and the sides at first flare outward for one-third their length and then turn abruptly inward. The papillæ are situated in the angles formed by these abrupt turns, and are hence marginal, unlike any other known species.

The antennæ are each armed with a pair of large triangular spines upon their basal joints. These also serve as a distinguishing mark, as no other known species possesses them. The teeth on the basal plate of the second maxillipeds are regular saw-teeth and are set close together. The three posterior pairs of swimming legs project considerably beyond the edge of the carapace, but the first pair only just reach it.

Flagella are present only on the first two pairs of legs. There are none on the third pair.

The testes in the male are enormous compared with the size of the animal, and not only occupy all the basal portion (considerably more than half) of the abdomen, but they also bulge out prominently on both the dorsal and ventral surfaces, giving the impression that they are full to bursting. They are each three-lobed (fig. 90).

Color.—From a clear brownish yellow to a red-brown, varying with age. The entire dorsal surface is covered with brown pigment spots, small and scattered on the carapace and thorax, larger and closer together on the abdomen. These pigment spots are much branched and each possesses a clear circular area near the center. The pigment on the ventral surface of the abdomen follows the creases between the lobes of the testes, leaving the lobes themselves a free color.

Length, 5 mm. (from 0.5 to 7 mm.); length of carapace, 3.5 mm.; breadth of carapace, 3.5 mm.; length of abdomen, 1.6 mm.; breadth, 1.10 mm.

Habitat.—From Buboka in Western Nyansa, Africa, upon frog tadpoles.

(*Ranarum* = of or pertaining to frogs).

These specimens were obtained by Dr. Stuhlmann from the external surface of the tadpoles, where they fix themselves to the skin by the hooks on the anterior maxillipeds.

They were very common, and often 5 or 6 were found upon the same host. Rarely they attached themselves inside the branchial cavity.

That they are similar in their habits to *Argulus* with such differences as are necessitated by the difference in structure of their first maxillipeds, can be seen from the following statement made by Bouvier (1899,² p. 13):

Les divers individus étaient fixés à la peau de leur hôte par leur bord antérieur, le reste du corps étant libre; leurs pattes notatoires étaient animées d'un mouvement actif, assurant ainsi les échanges respiratoires. Ils se détachaient librement ou se laissaient enlever avec des pinces, après quoi ils nageaient avec vivacité dans l'eau de la cuvette où ils étaient renfermés.

DOLOPS DISCOIDALIS Bouvier.

Gyropeltis kottari BOUVIER, 1897.

Gyropeltis discoidalis BOUVIER, 1899.¹

Dolops discoidalis BOUVIER, 1899.²

Carapace orbicular, wider than long; posterior sinus broad and about one-third the length of the carapace; lobes well rounded and separated from the thorax so as to leave a space between. Abdomen short and small, about 0.2, orbicular, somewhat narrowed anteriorly; anal sinus slit-like and not extending more than one-third the length of the abdomen.

The second antennæ have a triangular spine on the basal joint which is fully as large as the joint itself, but there are no spines at the base of the first antennæ.

The teeth on the basal plate of the second maxillipeds are blunt and rather widely separated. The two portions of the chela which terminates each first maxilliped are of about the same size, and each is stiffened with chitin.

The swimming legs just reach the edge of the carapace; each of the basipod joints of the posterior pair carries a very large flap on its posterior margin, those on the first joint being of the typical boot shape.

Each of the three anterior pairs of legs are furnished with flagella, those of the third pair being small, but fully developed.

Color.—Grayish green, with large rounded light-colored blotches arranged parallel with the margin of the body. Around the paired and median eyes these blotches fuse into large whitish areas.

Length, 11.8 to 14 mm.; length of carapace, 10 to 12 mm.; breadth of carapace, 10.6 to 14 mm.; length of abdomen, 3 to 3.5 mm.; breadth 4 to 4.3 mm.

Habitat.—From the Rio Nuba, in Brazil, on a species of *Platysoma*, called by the natives "Doncella" (*discoidalis*=disk-shaped, alluding to the carapace).

From a careful comparison of the genera and species here described we are enabled to deduce the following as the probable developmental history of the family. The primitive form from which the genera of the family have been developed through a greater or less adaptation to parasitic habits must have been very similar to the free copepods, a form possessing a moderate-sized, flattened carapace, three free thoracic segments, and a more or less lamellar abdomen. The anterior maxillipeds terminated in an ordinary-sized chela; there was no preoral sting; the mouth parts were very little, if at all, protrusible, and the ventral surface was unarmed with spines.

We find no species corresponding with this at the present time, because the first change, and one that must have taken place very quickly after the beginning of parasitic habits, was the making of

some provision whereby the parasite could cling more firmly to its host. This change resulted first in the further development of such appendages as were already adapted for clinging, such as the maxillipeds, etc., and the claws and spines upon these appendages were increased in size and strength or modified in form so as to be still better suited for such a purpose.

Then other appendages, such as the antennæ, etc., which were not originally or normally adapted to clinging or grasping, became gradually so greatly modified as to serve very poorly their original purpose, but are almost entirely given up to the acquired function. Such a condition as this we do find admirably illustrated in several of the so-called "unarmed" species of *Dolops*, such as *ranarum*, *longicauda*, etc.

As a further means toward this same end, prehension, the ventral surface of the carapace is next covered with spines pointing backward, a condition well illustrated by the so-called "armed" species of *Dolops*, such as *reperita*, *striata*, etc.

The wound and the subsequent irritation caused by forcing the enlarged claw-like hooks on the antennæ and the first maxillipeds into the flesh of the host must produce a copious flow of blood for the parasite. But these creatures are naturally very active, and they swim about freely, so that the forcing of their claws into their host, together with the subsequent withdrawal of them every time they wished to change their location, would impede considerably their freedom of motion. Consequently we next find the anterior maxillipeds entirely altered in structure, though still retaining their same function.

The terminal joints, with their stout hooks, are gradually absorbed, and in their place appear the circular sucking disks. These, through the creation of a partial vacuum by means of muscular action, cling as firmly to the skin of the host as did the claws, and they possess the further advantage that their hold can be taken or loosened instantaneously, thereby enabling the copepod to move about quickly over its host's body or to leave it and swim away.

This condition we find realized in the new genus *Chonopeltis*, recently described by Thiele (1901), where the anterior maxillipeds are modified into sucking disks, but otherwise the appendages are the same as in the "unarmed" species of *Dolops*. Curiously enough, there is also in this genus a complete suppression of the spines on the ventral surface, and there are no anterior or prehensile antennæ. Just what significance this may have in regard to the sequence of modifications can only be determined after the early development of the genus has been worked out.

But, while this change from claws to sucking disks in the anterior maxillipeds increases the facility of movement, it also deprives the parasite of his chief means of getting food. The sucking disks are

soft and they do not penetrate or even irritate the skin of the host. Consequently there can be no flow of blood following their use, and some other means for obtaining it must be provided.

This takes the form of a long, pointed sting or piercing organ, which is evertible and situated just in front of the mouth. This being thrust through the skin into the flesh of the host quickly brings a copious flow of blood, which the copepod then sucks up with its proboscis-like mouth parts.

This stage of modification is exemplified in the genus *Argulus*, and is the limit at the present time.

The genus *Argulus*, therefore, which includes three-fourths of all the species in the family, so far from being typical, is really the one which has undergone the greatest modification from the original primitive type. The genus *Dolops*, especially those species which are called "unarmed" by Bouvier, has undergone the least modification and retains most fully its primitive characteristics.

The genus *Chonopeltis* is intermediate between the other two and assists us in interpreting intelligently the various steps in modification which have been brought about by parasitic habits.

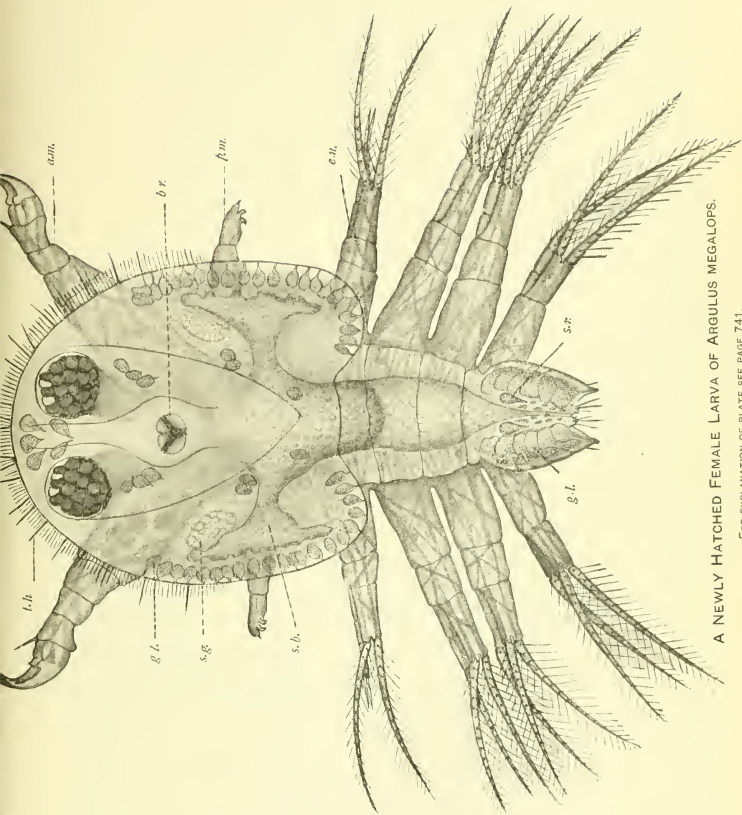
EXPLANATION OF THE PLATES.

All the drawings for both the text-figures and the plates were made with a camera lucida, unless otherwise stated.

Plate VIII. Newly hatched female larva of *argulus megalops*. *a m*, anterior maxilliped; *br*, brain; *cu*, endopod of first swimming foot; *gl*, skin glands; *p m*, posterior maxilliped; *s b*, side branch of the stomach; *s g*, shell gland; *s r*, semen receptacle; *t h*, tactile hairs.

- IX. Figs. 1-4, *Argulus latus*, ventral and dorsal surfaces, posterior maxilliped and antennæ, all of female.
- X. *Argulus laticauda*, fig. 5, ventral surface of male; fig. 6, dorsal surface of male; fig. 7, posterior legs and abdomen of female; figs. 8 and 9, antennæ and posterior maxilliped of male.
- XI. *Argulus megalops*, fig. 10, ventral surface of female; fig. 11, posterior maxilliped of male; fig. 12, antennæ of female; fig. 13, posterior legs of male showing accessory sexual organs. (See fig. 12 (in the text) for dorsal surface of female.)
- XII. *Argulus alosæ*, figs. 14, 15, 16, and 18, ventral and dorsal surfaces, antennæ, and posterior maxilliped of female; fig. 17, posterior legs and abdomen of male.
- XIII. *Argulus catostomi*, figs. 19-22, ventral and dorsal surfaces, antennæ, and posterior maxilliped of female.
- XIV. *Argulus funduli*, fig. 23, ventral surface of female; figs. 24 and 25, dorsal and ventral surfaces of male; figs. 26 and 27, antennæ and posterior maxilliped of male.
- XV. *Argulus pugettensis*, figs. 28-31, ventral and dorsal surfaces, antennæ, and posterior maxilliped of female.
- XVI. *Argulus lepidostei*, figs. 32, 34, and 35, ventral surface, antennæ, and posterior maxilliped of female; figs. 33 and 36, dorsal surface and posterior legs and abdomen of male.

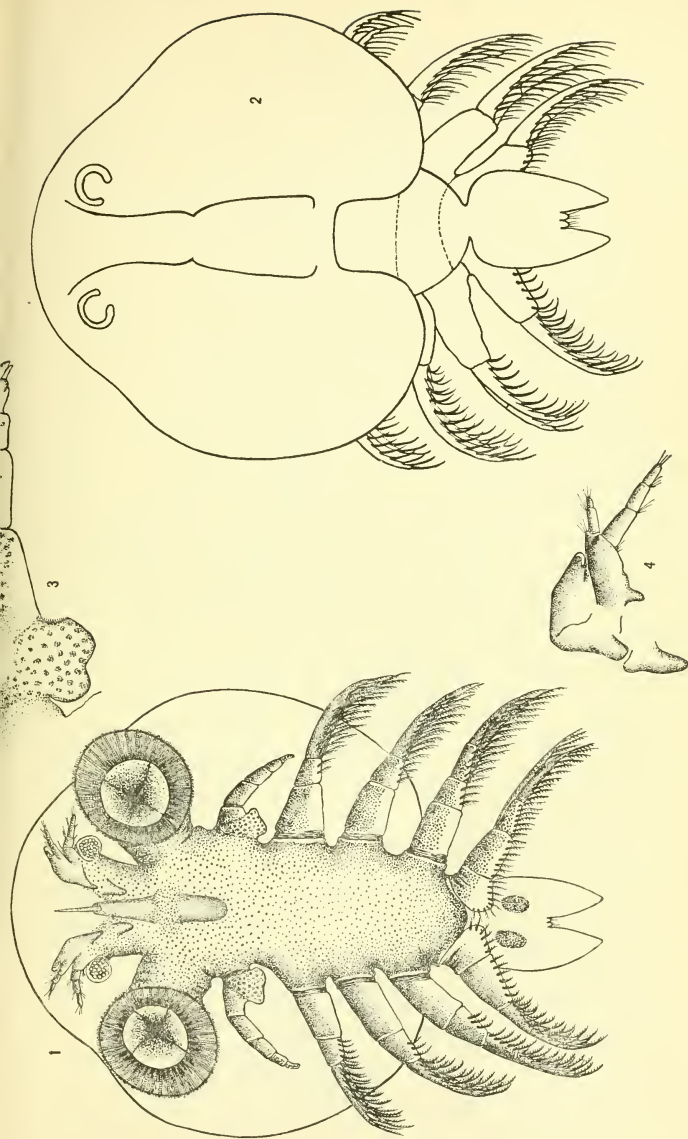
- Plate XVII. *Argulus stizostethii*, figs. 37-40, ventral and dorsal surfaces, antennæ, and posterior maxilliped of female; fig. 41, posterior legs of male.
- XVIII. *Argulus niger*, figs. 42-45, ventral and dorsal surfaces, posterior maxilliped and antennæ of female.
- XIX. *Argulus maculosus*, figs. 46, 48, and 49, ventral surface, antennæ, and posterior maxilliped of female; figs. 47 and 50, dorsal surface and posterior legs and abdomen of male.
- XX. *Argulus versicolor*, figs. 51, 52, 53, and 55, ventral and dorsal surfaces, posterior maxilliped and antennæ of female; fig. 54, posterior legs and abdomen of male.
- XXI. *Argulus americanus*, figs. 56, 58, and 59, ventral surface, antennæ, and posterior maxilliped, of female; figs. 57 and 60, dorsal surface and posterior legs and abdomen of male.
- XXII. Fig. 61, *Argulus elongatus*, female (after Heller); fig. 62, *Argulus chromidis*, female (after Kröyer); fig. 63, *Argulus uattereri*, female (after Kröyer); fig. 64, *Argulus salmii*, female (after Kröyer).
- XXIII. Fig. 65, *Argulus purpureus*, female (after Thorell); fig. 66, *Argulus melita*, female (after Van Beneden); figs. 67 and 68, *Argulus dactylopteri*, male and female (after Thorell).
- XXIV. Fig. 69, *Argulus foliaceus*, male (original drawing); figs. 70 and 71, *Argulus coregoni*, female and male (after Thorell); fig. 72, *Dolops longicauda*, posterior maxilliped of female (after Heller).
- XXV. Fig. 73, *Dolops longicauda*, anterior maxilliped of female (after Heller); fig. 74, *Dolops doradis*, antennæ of female (after Cornalia); fig. 75, *Dolops doradis*, dorsal surface of female (after Cornalia); fig. 76, *Dolops longicauda*, dorsal surface of male (after Heller); fig. 77, *Dolops kollari*, dorsal surface of male (after Heller); fig. 78, *Dolops geayi*, dorsal surface of male (after Bouvier).
- XXVI. Microphotographs of some North American Arguli. Fig. 79, *Argulus laticauda*, male; fig. 80, *Argulus alosæ*, female; fig. 81, *Argulus megalops*, male; fig. 82, *Argulus maculosus*, female; fig. 83, *Argulus versicolor*, female; fig. 84, *Argulus americanus*, male; figs. 85 and 86, ventral and dorsal surfaces of *Argulus americanus*, female; figs. 79, 81, 83, and 84 are of living specimens; figs. 80, 82, 85, and 86 are of preserved specimens.
- XXVII. Fig. 87, *Dolops reperta*, dorsal surface of female (original); fig. 88, *Dolops bidentata*, dorsal surface of male (original); fig. 89, *Dolops ranarum*, dorsal surface of female (original); fig. 90, abdomen of male, same species (original); fig. 91, *Argulus phocini*, dorsal surface of male (after Leydig).



A NEWLY HATCHED FEMALE LARVA OF ARGULUS MEGALOPS.

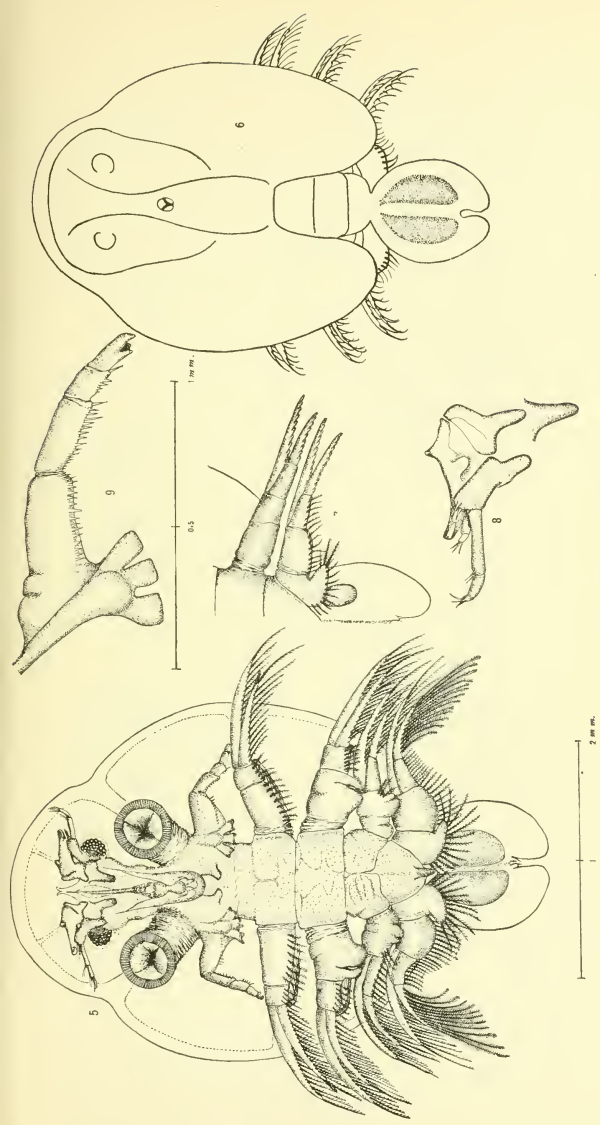
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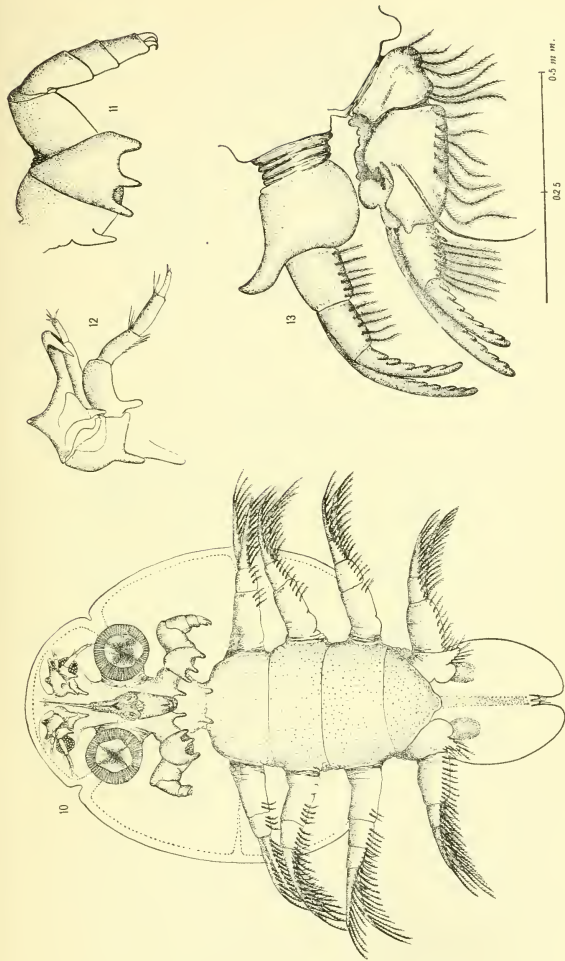
THE FEMALE OF ARGULUS LATUS.
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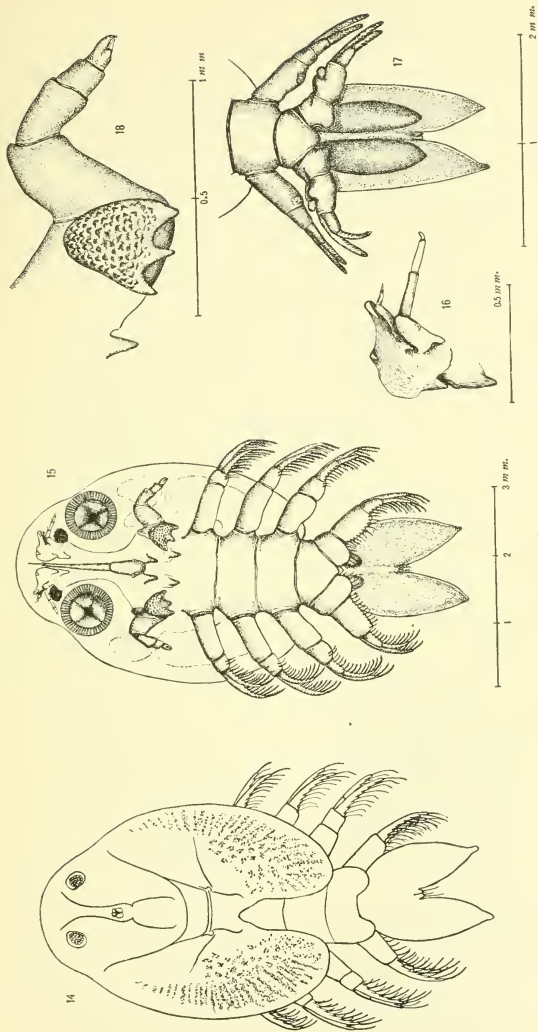
THE MALE AND FEMALE OF ARGULUS LATICAUDA.
FOR EXPLANATION OF PLATE SEE PAGE 741.





THE MALE AND FEMALE OF ARGULUS MEGALOPS.
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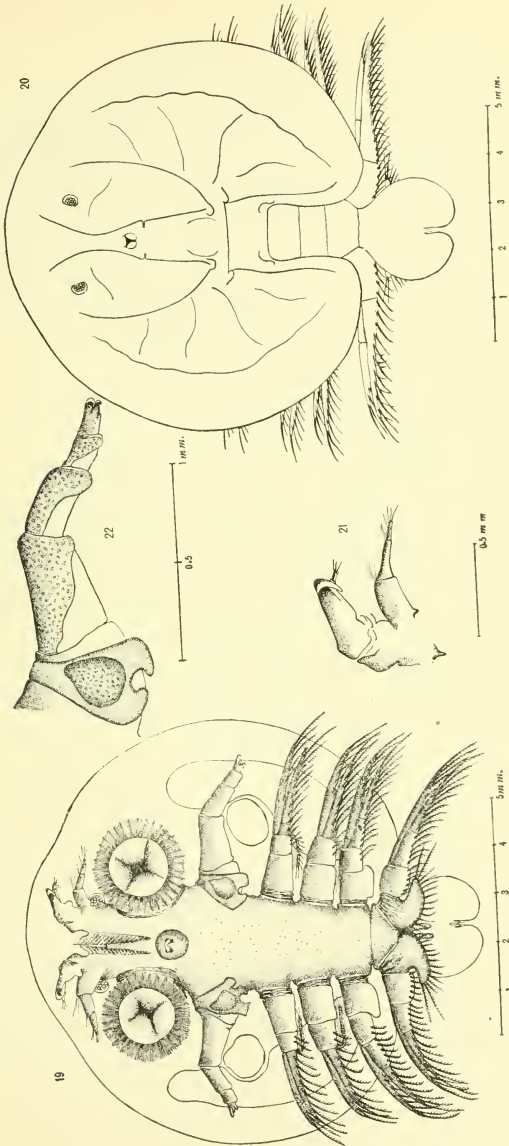




THE MALE AND FEMALE OF ARGULUS ALOSÆ.

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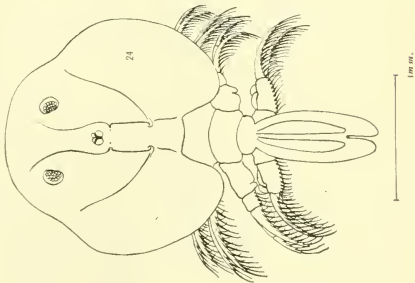
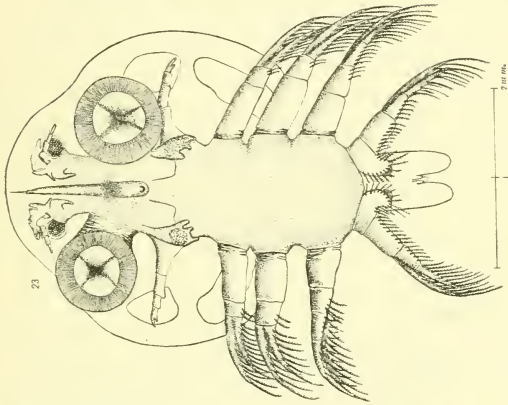
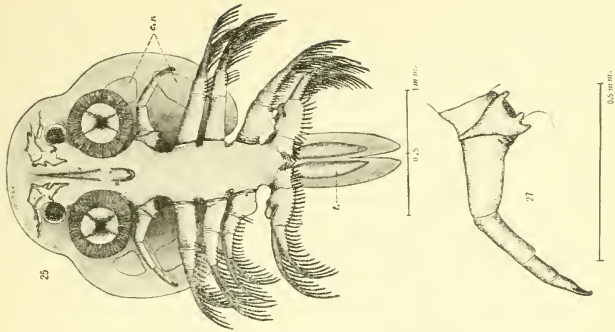




THE FEMALE OF ARGULUS CATOSTOMI.

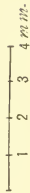
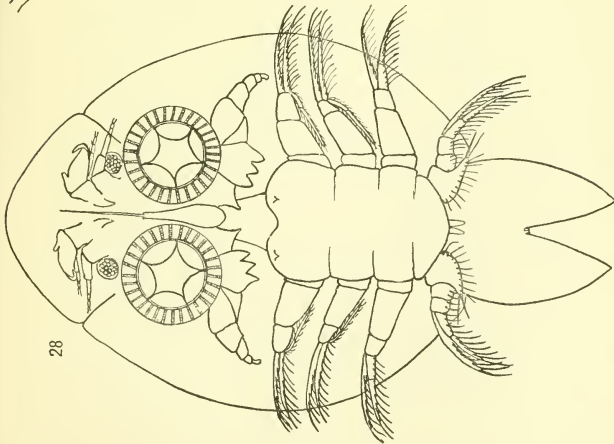
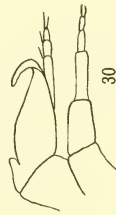
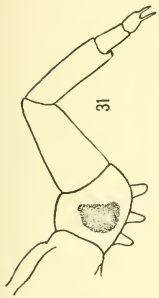
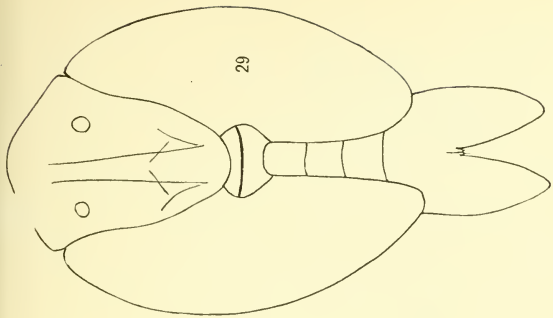
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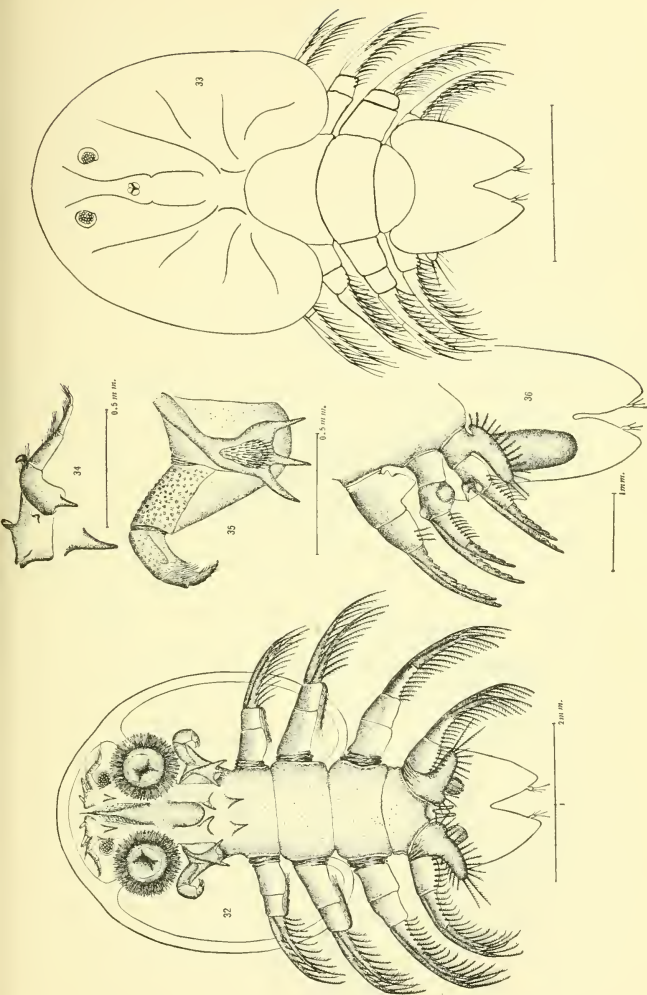
THE MALE AND FEMALE OF ARGULUS FUNDULI.
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THE FEMALE OF ARGULUS PUETTENSIS.
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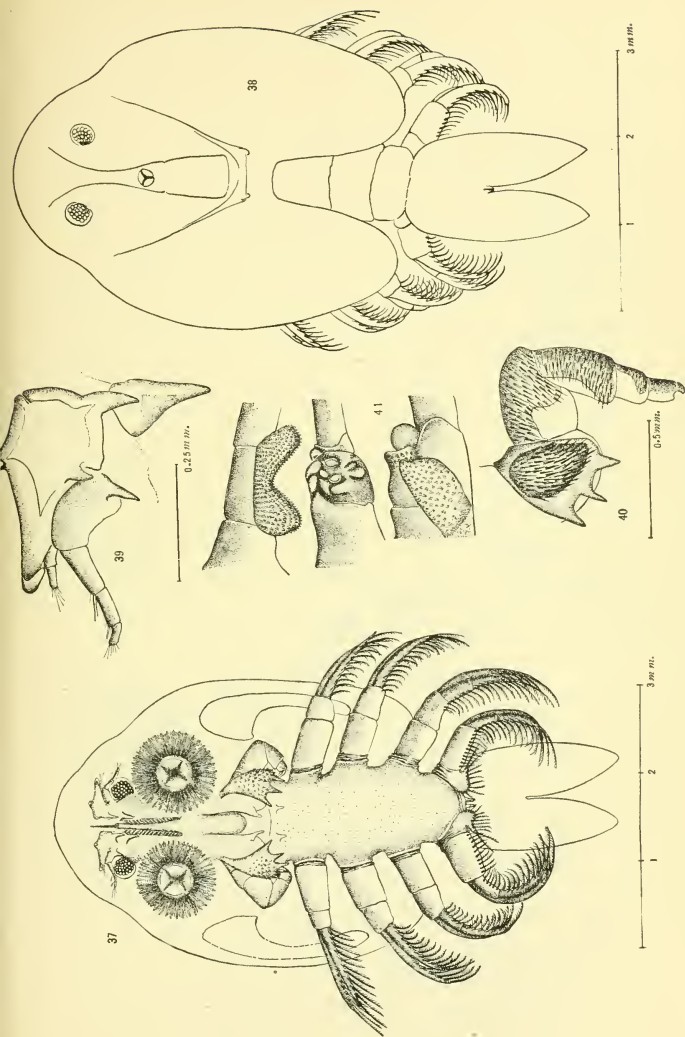




THE MALE AND FEMALE OF *ARGULUS LEPIDOSTEI*.

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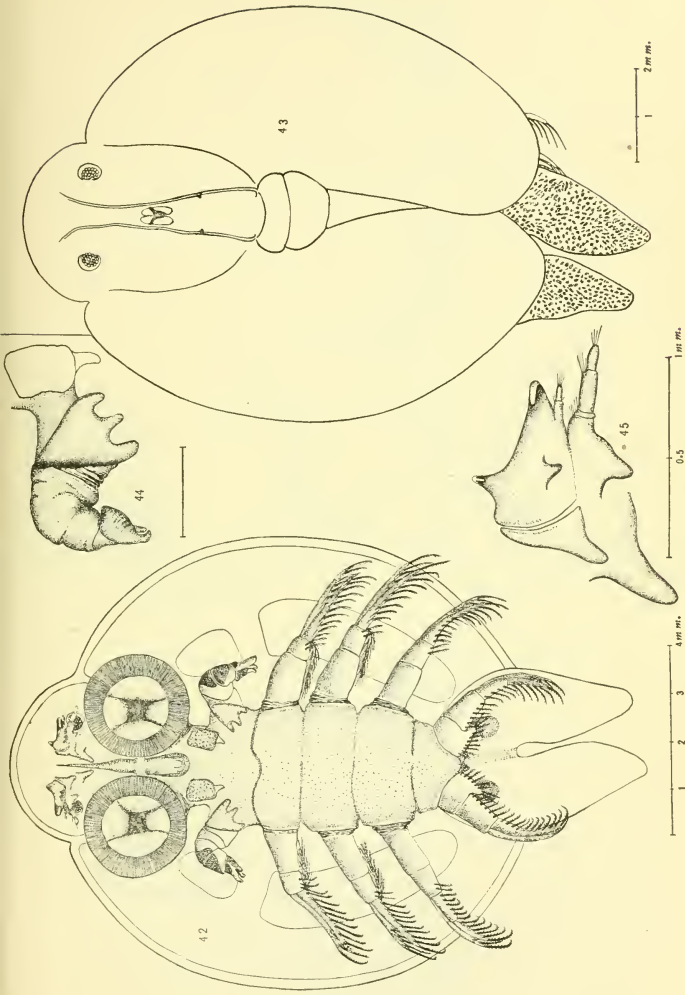




THE MALE AND FEMALE OF *ARGULUS STIZOTETHII*.

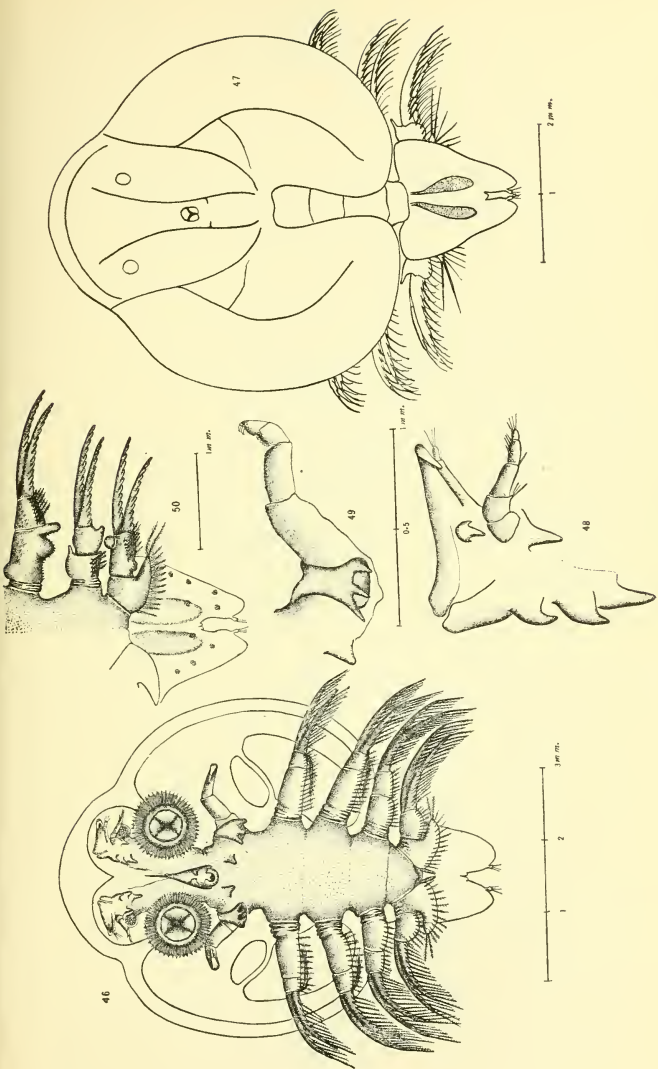
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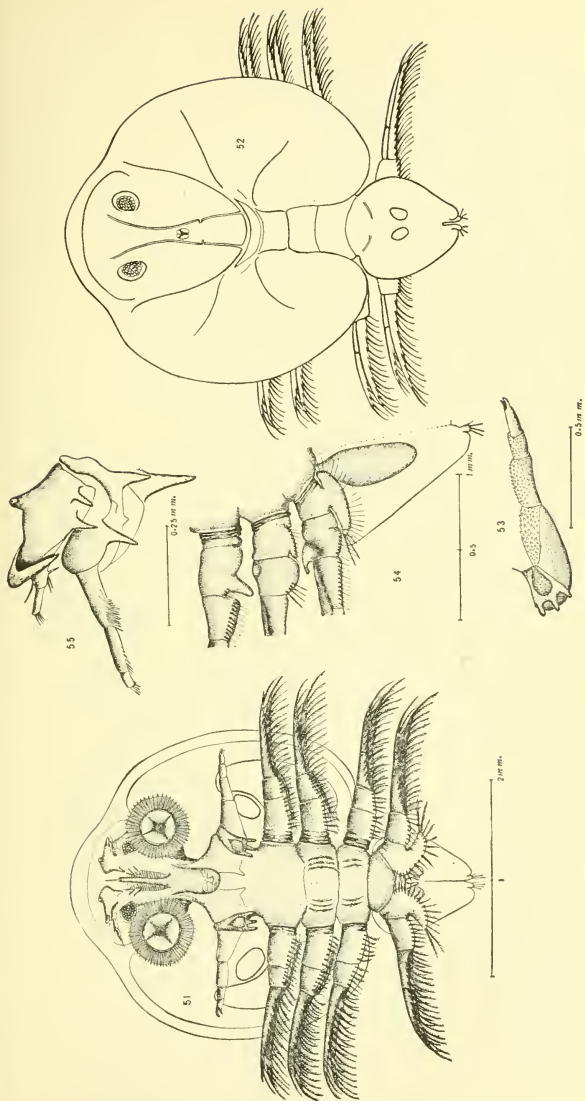
THE FEMALE OF ARGULUS NIGER.
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THE MALE AND FEMALE OF *ARGULUS MACULOSUS*.
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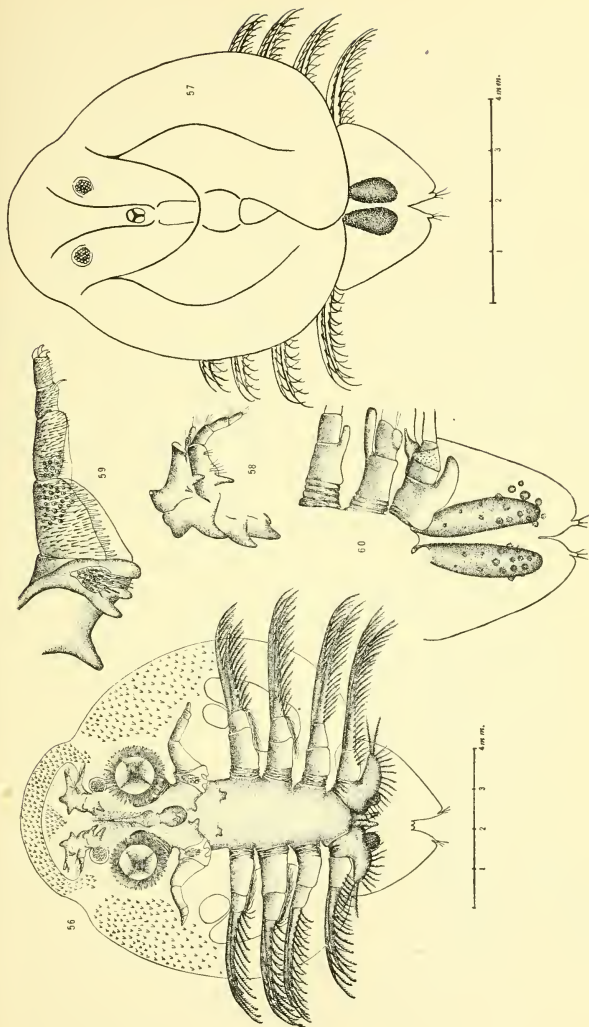




THE MALE AND FEMALE OF ARGULUS VERSICOLOR.

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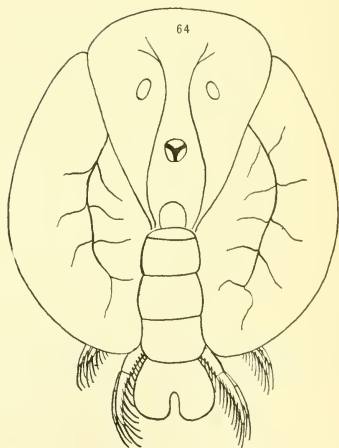
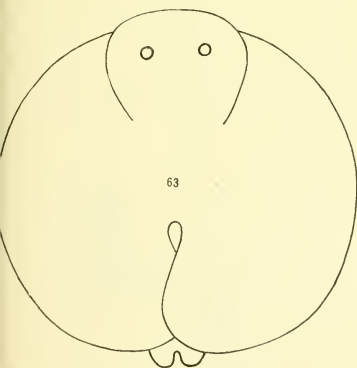
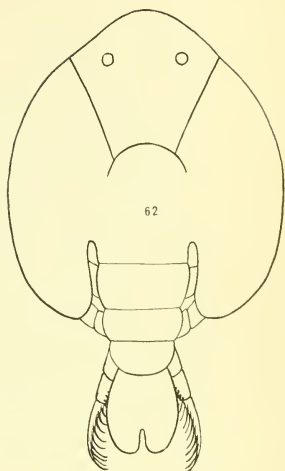
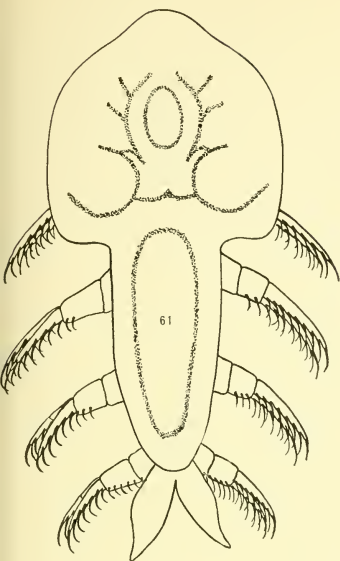




THE MALE AND FEMALE OF ARGULUS AMERICANUS.

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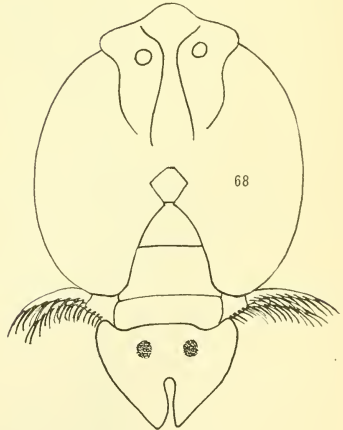
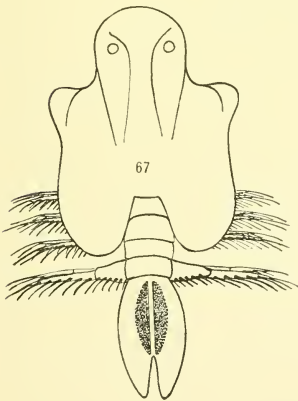
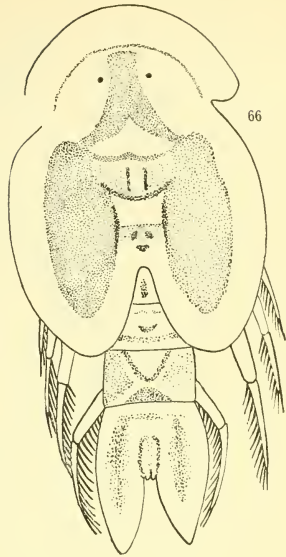
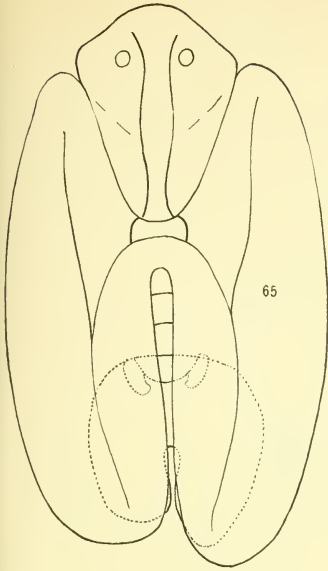


SOUTH AMERICAN MARINE ARGULI.

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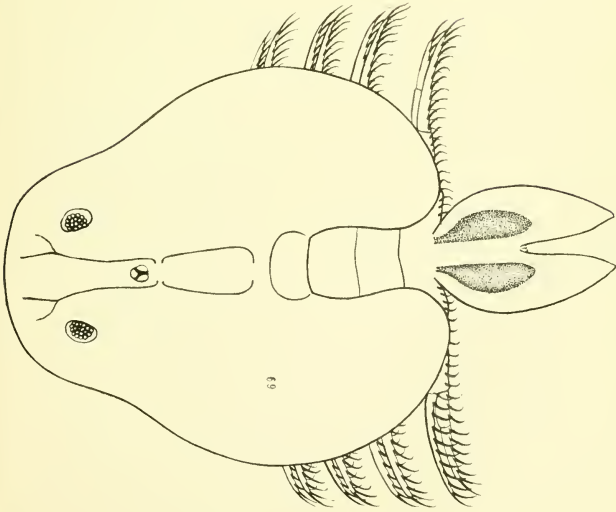
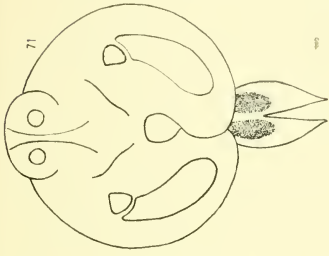
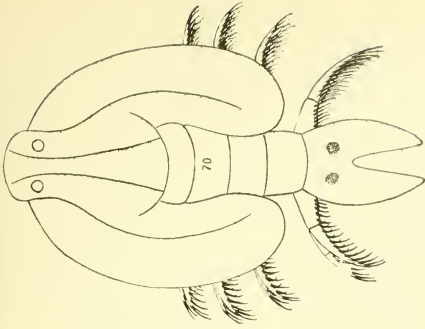
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NON-AMERICAN MARINE ARGULI

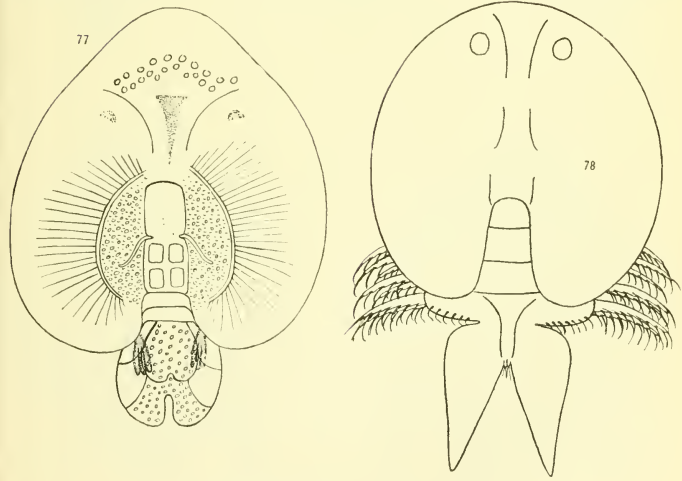
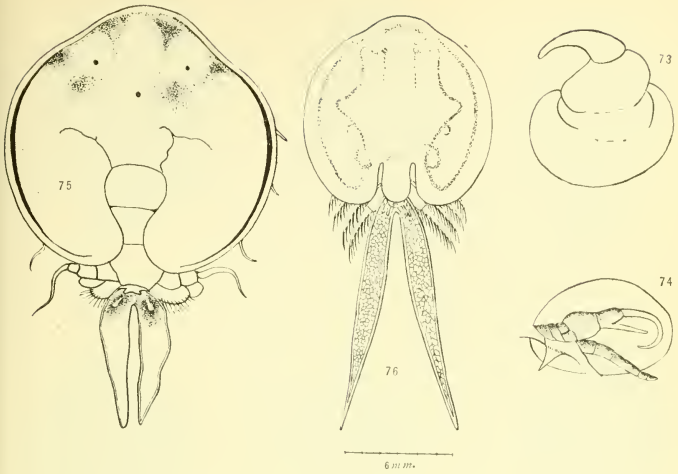
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EUROPEAN FRESH-WATER ARGULI.
FOR EXPLANATION OF PLATE SEE PAGE 742.



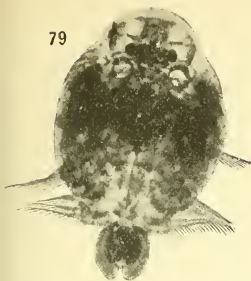


THE GENUS DOLOPS FROM SOUTH AMERICA

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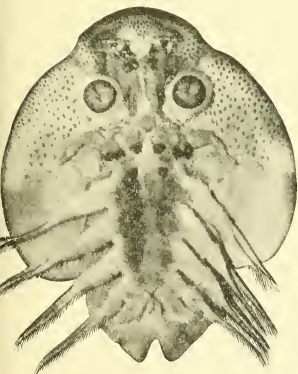
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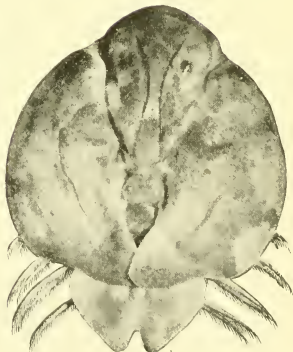
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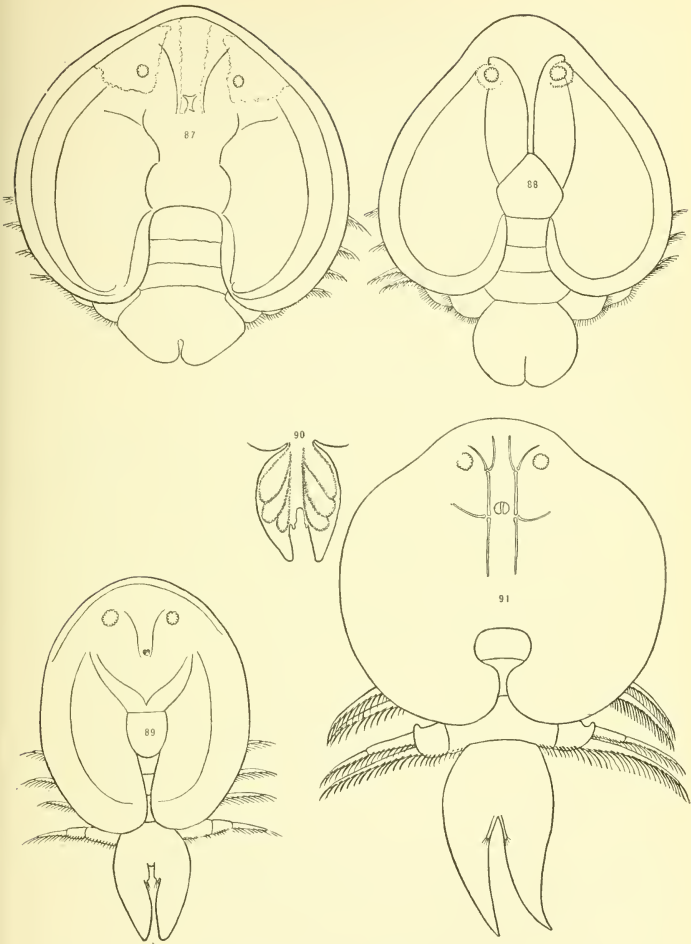
86



MICROPHOTOGRAPHS OF NORTH AMERICAN ARGULI.

FOR EXPLANATION OF PLATE SEE PAGE 742.





THE GENUS DOLOPS AND ARGULUS PHOXINI.

FOR EXPLANATION OF PLATE SEE PAGE 742.



A REVIEW OF THE OPHIDIOID FISHES OF JAPAN.

By DAVID STARR JORDAN and HENRY W. FOWLER.

Of the Leland Stanford Junior University.

In the present paper the writers give descriptions of the fishes of Japan belonging to the *Zoarcidæ*, *Ophidiidæ*, *Brotulidæ*, and related families, known as *Ophidioidea*. The material examined is that collected by Jordan and Snyder in 1900, with that belonging to the U. S. National Museum, together with certain specimens collected by the U. S. Fish Commission steamer *Albatross*. The plates are drawn by Mr. William S. Atkinson.

Group OPHIDIOIDEA.

This group, as a whole, agrees with the *Blennioidea* in all respects, except that no spines are developed in any of the fins, save sometimes in the posterior part of the dorsal. From the *Anacanthini*, with which the *Ophidioidea* agree in the jugular ventrals and in the absence of spines, they are separated by the form of the hypercoracoid, which is perforate, as in ordinary fishes. The group is a very large and varied one, widely distributed in all seas. The characters here used are all superficial, no comparative study of the skeletons having been made.

- a. Pseudobranchiæ well developed, very rarely small or obsolete.
- b. Ventral fins jugular, inserted much behind the eye, often wanting, never filamentous.
- c. Gill-membranes broadly united, free from the isthmus; ventrals wanting. CONGROGADIDÆ, I.
- cc. Gill-membranes united to the isthmus, the gill-openings lateral. ZOARCIDÆ, II.
- bb. Ventral fins developed as slender filaments attached at the throat not far behind eye.
- e. Gill-membranes nearly separate, free from the isthmus; body scaly. OPHIDIIDÆ, IV.
- aa. Pseudobranchiæ absent (or rudimentary in some *Brotulidæ*).
- f. Ventral fins wanting; no scales; vent at the throat. CARAPIDÆ, III.
- ff. Ventral fins well developed; vent posterior, normal; dorsal fin single, low; ventral fins short. BROTULIDÆ, V.

Family I. CONGROGADIDÆ.

Body elongate, compressed, naked, or covered with very small scales. Head compressed. Mouth moderate, horizontal, the lower jaw the longer; teeth moderate, no barbels. Gills 4, a slit behind the fourth;

pseudobranchiæ present. Gill membranes more or less broadly connected, free from the isthmus. Dorsal fin long and low, beginning near the tip of the pectoral or the middle of body, of slender, jointed rays; anal similar to dorsal, both connected with the caudal fin; tail tapering; pectoral fins small; ventral fins wanting. Vent remote from the head, without papilla. Vertebrae numerous. As here understood, this family consists of a few species of shore fishes of the Pacific.

a. Body covered with small scales; tail pointed, the dorsal and anal united around it; a short superior lateral line about $\frac{1}{3}$ the length of the body. *Hierichthys*, 1.

1. **HIERICHTHYS** Jordan and Fowler, new genus.

Hierichthys JORDAN and FOWLER, new genus (*encryptes*).

Body elongate, compressed, formed much as in *Pholis*, covered with small, smooth scales; a short superior lateral line about $\frac{1}{3}$ the length of the body; head compressed, rather pointed, the lower jaw projecting; mouth moderate, with a single series of strong, moderately large teeth in each jaw. Dorsal and anal low, continuous, of soft slender rays only, fully united with the caudal fin around the pointed tail; insertion of dorsal not far behind the nape; pectorals well developed; no ventrals. Japan.

(*ἱερον*, a temple, the Greek cognate of *Miyako*, the "Temple Island," where the type species was found.)

1. **HIERICHTHYS ENCRYPTES** Jordan and Fowler, new species.

Head $6\frac{1}{4}$; depth 10; D. 75; A. 64; P. 10; scales about 82 in a lateral series, about 30 in a vertical series in the middle of the body; head $1\frac{1}{3}$ in the trunk; head and trunk a little less than twice in tail; depth of body $1\frac{3}{8}$ in head; eye $1\frac{1}{3}$ in snout, $4\frac{3}{8}$ in head, 2 in maxillary; snout $3\frac{1}{2}$ in head; maxillary $2\frac{1}{3}$; pectorals about $3\frac{1}{2}$.

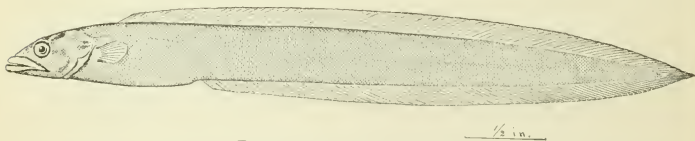


FIG. 1—HIERICHTHYS ENCRYPTES.

Body elongate, deep, and laterally compressed. Head greatly compressed laterally, so that it is little broader than the body; the snout sharply pointed and the lower jaw projecting; eyes lateral, rather close together; interorbital space a little more than half the eye, and convex; nostrils on the sides of the snout, the posterior very near the front margin of eye; maxillary long and reaching the middle of the eye; teeth moderately large, strong, and in a single series in each jaw; tongue long and pointed, free in front; lips rather broad and thick. Gill-openings very broad, the membrane forming a free fold over the isthmus.

Head naked, except the cheeks and upper portion of the opercles, which, together with the body, are covered with small cycloid scales.

Dorsal, anal, and caudal continuous, the latter terminating in a point medianly, low, and of more or less uniform height; origin of dorsal over posterior part of pectoral; pectorals short. Lateral line short, straight, not distinct, running high, traceable as far as the origin of the anal.

Color in alcohol pale brown with traces of darker mottlings and blotches; fins darker brown; a brown spot on opercle.

Length, $4\frac{7}{8}$ inches (112 millimeters).

Type.—No. 7120, Ichthyological Collections, Leland Stanford Junior University Museum. A single specimen, No. 613 of Ishikawa's catalogue, from the island of Myiako-shima in the Riu Kiu. Presented by the Imperial Museum of Tokyo.

(*ἔνκρúπτης*, one hidden.)

Family II. ZOARCIDÆ.

EELPOUTS.

Body elongate, more or less eel-shaped, naked or covered with very small, embedded, cycloid scales; head large; mouth large, with conical teeth in jaws, and sometimes on vomer and palatines; bones of head unarmed. Gill-membranes broadly united to the isthmus, the gill-opening reduced to a vertical slit; pseudobranchiæ present; gills 4, a slit behind the fourth. Dorsal and anal fins very long, of soft rays only, or the dorsal with a few spines in its posterior portion; vertical fins sometimes confluent around the tail; pectorals small; ventrals jugular, very small or wanting; if present, inserted behind the eye. Lateral line obsolete or little developed, sometimes bent downward behind pectorals, sometimes sending a branch on median line backward. Gill-rakers small; pyloric caeca rudimentary; vent not near head. Pseudobranchiæ present. Genera about 15; species 50. Bottom fishes, chiefly of the Arctic and Antarctic seas; some of them, at least, are viviparous, and some descend to considerable depths. Dr. Gill thus enumerates the skeletal characters of the *Zoarcidæ*:

Orbito-rostral portion of the cranium contracted and shorter than the posterior, the cranial cavity open in front, but bounded laterally by the expansion of the annectant parasphenoid and frontals, with the supraoccipital declivous and tectiform behind, the occipitals above inclined forward along the sides of the supraoccipital, and the exoccipital condyles distant, with the hypercoracoid foraminate about its center, and the hypocoracoid with an inferior process convergent to the proscapula. These characters are formulated from the skeleton of *Zoarces anguillarís*.

a. Zoarcinæ: Dorsal fin low behind, some of its posterior rays short and spine like; ventrals small; scales present; teeth strong, conic, in jaws only; lateral line present along middle of side.

- aa. Dorsal fin continuous, of soft rays only *Zoarces*, 2.
 b. *Lycodinae*: Ventral fins present.
 c. Vomer and palatines with teeth; lower jaws without barbels; dorsal fin without sculptured scutes at base; body slender, the depth 12 to 20 in the length; lateral line lateral in position; pectoral fin with rounded outlines, the lower rays not greatly produced *Lycenchelys*, 3.
 bb. Ventral fins entirely wanting.
 d. *Gymnelinae*: Teeth moderate, nearly uniform on jaws, vomer, and palatines; body scaly; body compressed, not very slender; skull cavernous. *Bothrocaru*, 4.

2. ZOARCES Cuvier.

Enchelyopus KLEIN, Ichthyologia, Missus, IV, 1747, p. 52 (non-binomial; not of BLOCH and SCHNEIDER = *Rhinonemus* GILL).

Zoarces CUVIER, Règne Animal, 2d ed., II, 1829, p. 175 (*viviparus*).

Zoarchus SWAINSON, Nat. Hist. Class'n Fishes, II, 1839, p. 283 (*viviparus*).

Enchelyopus GILL, Proc. Ac. Nat. Sci. Phila., 1863, p. 258 (*viviparus*; not of BLOCH and SCHNEIDER).

Macrozoarces GILL, Proc. Ac. Nat. Sci. Phila., 1863, p. 258 (*anguillaris*).

Body elongate, compressed, tapering posteriorly; head oblong, heavy, narrowed above, the profile decurved; mouth large; teeth strong, conic, bluntish in 2 series in the front of each jaw and 1 series on the sides; teeth in outer series larger; no teeth on vomer or palatines; dorsal fin very long, low, some of its posterior rays much lower than the others, developed as sharp spines; pectoral fins broad; ventrals jugular, of 3 or 4 soft rays; scales small, not imbricated, embedded in the skin; lateral line slender, lateral in position; size large; species viviparous. The American and Asiatic species (subgenus *Macrozoarces*) differ from the European type of *Zoarces* Cuvier, in the increased number of fin rays and vertebrae. In *Zoarces viviparus* (Linnæus), the European eelpout, the dorsal rays are about 100, the anal about 85, and the number of vertebrae is proportionally diminished.

(ζωαρκής, viviparous.)

2. ZOARCES ELONGATUS Kner.

Zoarces sp. KNER, Neue Fische, Godeffroy Mus., 1865, p. 13; Decastris Bay, Manchuria.

Zoarces elongatus KNER, Sitzungsber. Akad. Wiss. Wien, 1868, p. 52, pl. VII, fig. 2; Okhotsk Sea (No. 1502 Wien. Mus.).

Head $6\frac{1}{2}$ to $6\frac{2}{3}$; depth 9 to $11\frac{1}{2}$; D. 80 to 86-VII to XVI-28 to 30; A. 95 to 98, or more; P. 20; depth of body $1\frac{2}{3}$ to $1\frac{3}{4}$ in head; eye 4 to 7; snout $3\frac{2}{3}$ to $5\frac{1}{2}$; maxillary $2\frac{1}{2}$ to $3\frac{1}{3}$; pectoral $1\frac{1}{4}$ to $1\frac{1}{2}$; head $1\frac{1}{2}$ to $1\frac{1}{4}$ in trunk; head and trunk $1\frac{1}{2}$ to $1\frac{1}{3}$ in tail.

Body rather stout, compressed, elongate, and tapering to a point behind. Head oblong, compressed; snout blunt, very obtuse, convex, and rounded; eyes small, anterior, lateral in position, and much larger in the young; nostrils on the sides of the snout, small, and nearer the

tip of the snout than the eye; lips very broad and fleshy; mouth large, the maxillary a little beyond the eye; teeth short, conical, rounded above, and in a single series in the upper, and in two series in the lower jaw in front; tongue very broad, thick, rounded, and little free in front. Gill-openings large, the isthmus broad, and the gill-membranes joined to it.

Head, pectorals, region around ventrals, dorsal and anal anteriorly, naked; scales of body very small, round, numerous, and cycloid; small scales upon the basal portions of the dorsal and anal posteriorly.

Dorsal beginning before the gill-opening, highest anteriorly, also higher than the anal, continuous with the caudal and anal, and with a small lower spinous portion, the origin of which is distant from the tip of the caudal about the length of the head; caudal small and pointed; pectoral broad, and the lower rays thick and fleshy; ventrals jugular, their insertion directly behind the margin of the preoperculum, and their length a trifle greater than the eye. Lateral line obsolete after the middle of the body.

Color in alcohol dark brown; edge of dorsal blackish brown, and the fin and back with about 18 deep-brown λ -shaped marks, below which, on the sides, are a series of deep-brown blotches; a narrow streak from the eye backward; scales rather pale.

Length $12\frac{1}{2}$ inches (31 millimeters).

The specimen from which the above description is taken was obtained at Iwani, in Shiribeshi, Hokkaido.

A specimen from Hakodate, in the museum at Hakodate, has 105 dorsal rays, the spinous part short; body with about 21 dark cross-bands, λ -shaped, and each with a spot below; pectorals nearly as long as head; ventrals very short; mouth large, extending to middle of eye.

In a specimen from Sagalin Island, presented by the Imperial Museum of Japan, the dorsal has 87-VI-28 rays and spines.

In our smallest example, from Tishima, Hokkaido, the spinous fin is very long, of XIV spines, farther from the tip of the tail than the length of the head, about the fifth, sixth, and seventh dorsal rays above, a deep-brown round spot; scales small; length $4\frac{3}{4}$ inches (121 millimeters).

In spite of the variation exhibited in these specimens, they do not appear to us to justify specific distinction.

(*elongatus*; elongate.)

3. LYCENCHELYS Gill.

Lycenchelys GILL, Proc. Acad. Nat. Sci. Phila., 1884, p. 110 (*murana*).

This genus contains small and very slender species, differing from *Lycodes* in the elongation of the body, the depth being from 10 to 20 times in the length. The lateral line is single and median in all known species. The genus is very close to *Lycodes*, but the position

of the lateral line sufficiently defines it, especially in connection with the slender, eel-like form.

(λύκος, wolf; ἔγχελυς, eel.)

3. LYCENCHELYS PÆCILIMON Jordan and Fowler, new species.

Head $5\frac{1}{4}$; depth 13; D. 107; A. 90; P. 17; depth of body $2\frac{2}{5}$ in head; snout $4\frac{2}{3}$; eye $3\frac{1}{5}$; maxillary 2; pectoral $1\frac{1}{5}$; head a little over 1 in trunk; head and trunk $1\frac{1}{4}$ in tail.

Body elongate, the depth more or less uniform, greatest behind head, and the trunk tapering behind; compressed, and the width of the head greater than the greatest width of the body. Head elongate, oblong; snout rather blunt, obtuse, and convex above; eyes large, elongated, anterior, somewhat directed upward, very close together and greater than the snout; lips moderately broad; mouth large, the maxillary reaching a little beyond the posterior margin of the eye; teeth rather large, strong, pointed, and in a single series in each jaw,

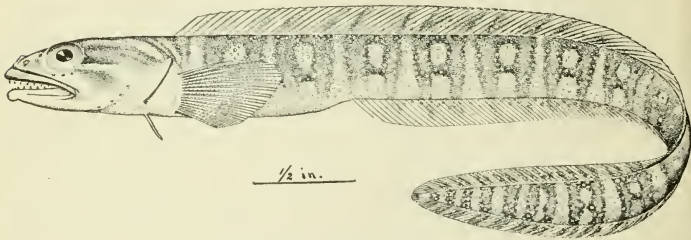


FIG. 2.—LYCENCHELYS PÆCILIMON.

those of the upper jaw the larger; tongue thick, rounded, rather long, and not free in front. Gill-openings large, lateral, the membranes broadly united to the isthmus.

Head naked, also the nape, region about ventrals, and pectorals; body covered with small, round cycloid scales; the greater portion of the basal parts of the vertical fins posteriorly with small scales.

Dorsal almost over the base of the pectoral but posterior to the gill-opening, and, like the anal, uniform in height to near the end of the tail, which is bluntly pointed; pectorals moderately broad and pointed; ventrals thoracic, rather slender, about equal to eye. Lateral line obsolete, a trace running along the middle of the sides.

Color in alcohol pale brown; sides with 11 H-shaped, deep-brown markings extending on the vertical fins, posteriorly these lose the middle and upper connecting bars and form about 8 deep-brown vertical bars; upper surface of head brownish, with several oblique bars across, one from the eye; lips blackish brown above; lower surface of the trunk, pectorals, ventrals, and anterior portion of anal pale.

Length $5\frac{1}{8}$ inches (150 millimeters).

Type.—No. 50578, U. S. National Museum.

Locality, Station 3768, off Kinkwazan in Matsushima Bay, where it was dredged by the U. S. Fish Commission steamer *Albatross*.

This species is known to us from the type described above, and another small specimen, cotypical, is No. 7121, Ichthyological Collections, Leland Stanford Junior University.

(*ποικιλείμων*, in varied garb.)

4. BOTHROCARA Bean.

Bothrocara BEAN, PROC. U. S. Nat. Mus.; 1890, p. 38 (*mollis*).

Body elongate, compressed, semitranslucent, covered with small scales; small teeth in jaws and on vomer and palatines; mucous pores about head largely developed, no ventral fins; dorsal and anal joined to caudal. Deep-sea fishes allied to *Lycodes*, but lacking ventrals.

(*βόθρος*, cavity; *κάρα*, head.)

4. BOTHROCARA ZESTA Jordan and Fowler, new species.

Head 5; depth $8\frac{2}{3}$; D. 112; A. 92; P. 17; eye $6\frac{1}{2}$ in head; 2 in snout; $1\frac{2}{3}$ in interorbital space; $2\frac{2}{3}$ in maxillary; snout $3\frac{1}{2}$ in head; maxillary $2\frac{1}{2}$ in head; depth of head $1\frac{2}{3}$ its length; pectoral 2 in head; head 1 in trunk; head and trunk $1\frac{1}{2}$ in tail; width at corners of mouth 3 in head.

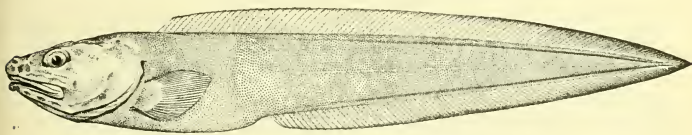


FIG. 3.—BOTHROCARA ZESTA.

Body elongate, greatly compressed, and tapering to a point. Head very broad, its breadth $1\frac{1}{4}$ in its length; large muciferous cavities covered with rather strong soft membrane; eye rather small, high, and before the center of the length of the head; maxillary large and reaching to below the posterior part of the eye; teeth in the upper jaw in two series, the outer the larger; teeth in lower jaw in a single series on the sides and in front with several series forming a rather large patch about the symphysis; palatine and vomerine teeth in a single series; tongue rather large, thick, rounded, and free in front; nostrils each in a small tube nearer the tip of the snout than the eye and a trifle nearer each other than the interorbital space; interorbital space rather convex; snout produced, rounded; lips fleshy; upper jaw produced beyond the lower. Gill-opening large, the gill-membrane rather narrowly joined to the isthmus; pseudobranchiae a few small

filaments; gill-rakers rather numerous and of moderate size; branchiostegals strong and 6 in number.

Head naked, the body covered with very small round cycloid scales.

Dorsal, anal, and caudal continuous, the latter terminating in a sharp point; origin of the dorsal a little behind the base of the pectoral; pectoral broad and pointed. Lateral line absent.

Color in alcohol plain brown, each scale on the body a little lighter; pectorals pale with their basal portions brownish; gill openings black inside.

Length, 19 inches (482 millimeters).

Type.—No. 50576, U. S. National Museum.

Locality, Station 3696, Sagami Bay, from the U. S. Fish Commission steamer *Albatross* dredgings.

Cotypes from Station 3696, in Sagami Bay, where they were dredged by the U. S. Fish Commission steamer *Albatross*, are in the Leland Stanford Junior University.

This species is very close to *Bothrocara mollis* of Bean, and is distinguished chiefly by the increased number of dorsal and anal rays, which are at least 112 without any of the caudal rays.

(ζεστός, soft boiled, in allusion to the cavernous head.)

Family III. CARAPIDÆ.

PEARL-FISHES.

Body elongate, compressed, tapering into a long and slender tail; no scales; teeth cardiform on jaws, vomer, and palatines; canine teeth often present; no barbels; lower jaw included; vent at the throat; gill-membranes somewhat united, free from the isthmus; no pseudo-branchiæ; no pyloric cæca; vertical fins very low, confluent, without spines; no ventral fins; pectoral fins present or absent. Small shore fishes of tropical seas, often living in shells of mollusks, echinoderms, etc., being especially often commensal with the pearl oyster and with the larger *Holothuria*.

a. Pectoral fins present; no distinct caudal fin; gill-membranes connected anteriorly only *Carapus*, 5

3. CARAPUS Rafinesque.

Carapus RAFINESQUE, Indice. Ittiol. Siciliana, 1810, p. 57 (*acus*; originally intended for a *Gymnotus*).

Fierasfer CUVIER, Règne Anim., 1st. ed., II, 1817, p. 2393 (*imberbe* = *acus*).

Echiodon THOMPSON, Proc. Zool. Soc. Lond., 1837, p. 55 (*drummondii*).

Diaphasia LOWE, Proc. Zool. Soc. Lond., 1843, p. 92 (*acus*).

Orybeles RICHARDSON, Voy. Erebus and Terror, Fishes, 1846, p. 74 (*homei*).

Porobronchus KAUP, Ann. Mag. Nat. Hist., 1860, p. 272 (larva of *Fierasfer acus*).

Carapus GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 152 (after Rafinesque, 1810).

Vexillifer GASCO, Bull. Assoc. Nat. Med. Napoli, 1870, p. 59 (larva of *Fierasfer acus*).

Lefroyia JONES, Zoologist, IX, 1874, p. 3838 (*bermudensis*).

Gill-membranes little connected, leaving the isthmus bare. No distinct caudal fin; pectoral fins developed. The species of this genus are not well known, and their characters and nomenclature are uncertain.

(*Carapo*, the Portuguese name of *Gymnotus*, with which genus this fish was supposed to be congeneric. In case the name *Carapus* is regarded as a synonym of *Gymnotus* the name *Fierasfer* should be restored.)

5. CARAPUS KAGOSHIMANUS (Steindachner and Döderlein).

Fierasfer kagoshimanus STEINDACHNER and DÖDERLEIN, *Fische Japans*, IV, 1887, p. 27; Kagoshima.

Head $7\frac{1}{2}$ (in total); depth $13\frac{1}{2}$ (in total); eye $1\frac{2}{3}$ in snout; $3\frac{1}{3}$ in head; $2\frac{1}{2}$ in interorbital space; head $2\frac{1}{2}$ times as long as wide, and $1\frac{2}{3}$ times as long as deep; pectoral $2\frac{1}{3}$ in head. Small teeth in both jaws, on the vomer and palatines, the vomerine in a short band. Gill-openings broad; the united gill-membranes joined only to a small part of the isthmus. Vertical fins very low, the dorsal no more than $\frac{2}{4}$ the length of the body; origin of anal below base of pectoral. Color uniform pink; top of head with fine black dots. Length $4\frac{1}{3}\frac{1}{2}$ inches (110 millimeters). Locality, harbor of Kagoshima. (Steindachner and Döderlein.)

Not seen by us.

Family IV. OPHIDIIDÆ.

CUSK-EELS.

Body elongate, compressed, more or less eel-shaped, usually covered with very small scales, which are not imbricated, but placed in oblique series at right angles with each other; head large; lower jaw included; both jaws, and usually vomer and palatines also, with villiform or cardiform teeth; premaxillaries protractile; gill-openings very wide; the gill-membranes separate, anteriorly narrowly joined to the isthmus behind the ventrals; pseudobranchiæ small. Gills 4, a slit behind the fourth; vent more or less posterior. Vertical fins lower, without spines, confluent around the tail; tail isocercal; ventral fins at the throat, each developed as a long forked barbel. Air bladder and pyloric cæca present. To this Dr. Gill adds also the following characters, shared more or less by related families: "Orbitorostral portion of cranium contracted and shorter than the posterior, the cranial cavity closed in part by the expansion and junction of the parasphenoid and frontals, the supraoccipital horizontal and cariniform posteriorly, the exoccipitals expanded backward and upward behind the supraoccipital, the exoccipital condyles contiguous, and with the hypercoracoid (scapula, Parker) fenestrate (or foraminated) about its center, and the hypocoracoid with its inferior process divergent from the proscapula."

Genera 7, species about 25. Carnivorous fishes, found in most warm seas, some of them descending to considerable depths, the group especially well represented in tropical America.

a. Head scaleless; scales of body rudimentary, scarcely embedded; opercle ending in a sharp spine, concealed by the skin; air bladder short and broad, with a large foramen behind *Otophidium*, 6

6. OTOPHIDIUM Gill.

Otophidium GILL, in Jordan, Cat. Fish. North Amer., 1885, p. 126 (*omostigma*).

This genus differs from *Ophidion* in the form of the air bladder, which is short and thick and with a large foramen. The opercle ends in a concealed spine as in *Chilara*.

(*ov*₅, ear: *Ophidium*.)

6. OTOPHIDIUM ASIRO Jordan and Fowler, new species.

Head 5; depth $6\frac{5}{6}$; D. 155; A. 125; P. 25; eye 4 in head, $2\frac{1}{3}$ in maxillary; snout 5 in head, $2\frac{2}{3}$ in maxillary; maxillary $1\frac{5}{6}$ in head; pectoral $2\frac{1}{3}$; depth of head $1\frac{1}{3}$ in its length; head 1 in trunk; head and trunk $1\frac{2}{3}$ in tail.

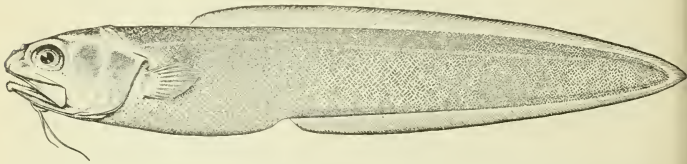


FIG. 4.—*OTOPHIDIUM ASIRO*.

Body elongate, deep and compressed, the tail tapering to a point. Head compressed, about as broad as body in front; snout rather bluntly rounded; eye large, its posterior edge much nearer tip of snout than gill-opening; maxillary reaching a little beyond posterior margin of eye, and its distal extremity expanded so that it is equal to $\frac{1}{3}$ its length; nostrils rather small directly in front of the eye; teeth in rather broad bands in the jaws, and with an outer enlarged series; vomerine and palatine teeth conical; tongue rather slender, pointed, and adnate to the floor of the mouth. Gill-openings very large, joined to the isthmus; pseudobranchiae of a few small filaments; gill-rakers large, 3 + 3 in the first arch. Opercular spine large, covered by skin.

Head naked; body covered more or less with elongated small cycloid scales.

Dorsal, anal, and caudal continuous, the latter terminating in a point; origin of the dorsal before the tip of the pectoral; pectoral rather small, its margin rather pointed; ventrals jugular, of two rather long

filaments, the longest about $1\frac{1}{2}$ in head, and their bases anterior to the middle of the eye. Lateral line superior, on the back, and concurrent with its dorsal outline to the base of the caudal. Air bladder large, thick, and short, with a large foramen.

Color in alcohol plain uniform brown, the edges of the caudal, dorsal, and anal blackish brown; opercles brassy.

Length, $8\frac{1}{3}$ inches (204 millimeters).

Type.—No. 7123. Ichthyological collections, Leland Stanford Junior University Museum. Locality, Misaki; presented by the Imperial University of Tokyo.

(*asiro*, the vernacular name.)

Family V. BROTULIDÆ.

Body elongate, compressed, regularly tapering behind, the tail generally subtruncate at base of caudal fin, not isocercal; vent submedian; cales cycloid and minute, embedded in the lax skin, which more or less envelops the fins, sometimes wanting; mouth large, with teeth usually on broad bands on jaws, vomer, and palatines; gill-openings very large, the membranes mostly free from the isthmus; vertical fins united or continuous at base of caudal; dorsal fin beginning not far from nape; caudal narrow or pointed; ventral fins small, few-rayed, attached to the humeral arch and more or less in advance of pectoral. Pyloric æca few (1 or 2), rarely obsolete or in increased number (12); maxillaries generally enlarged behind and produced toward the upper angle. Pseudobranchiæ small or wanting, hypercoracoid with the usual foramen, as in Blennioid fishes. These fishes are closely related to *Zoarçidæ*. In spite of curious external resemblances to the *Gadidæ*, their affinities are decidedly with the Blennioid forms rather than with the latter. Species largely of the depths of the sea; 2 species in Cuba degenerated into blind cave fishes.

a. Brotulina: Snout and lower jaw each with about 3 long barbels; vertical fins united; ventrals close together, each of two rays divided at the tips . . . *Brotula*, 7

a. Snout and lower jaw without barbels.

b. Bythitina: Caudal not differentiated, on a distinct caudal peduncle; eyes well developed; body scaly; ventrals inserted on the isthmus near the humeral symphysis; deep-sea species.

c. Pectoral fins normal, the lower rays not elongate.

d. Ventral fins close together, each of a single undivided ray; lateral line simple, obsolete behind; preopercle unarmed; opercle with a single spine.

e. Head naked, covered with loose skin, with fine papillæ; bones of skull extremely cavernous *Myxocephalus*, 8

ee. Head largely scaly *Sirenbo*, 9

dd. Ventral fins of two rays each, separated at tip.

f. Lateral line simple, indistinct posteriorly.

g. Preopercle unarmed; head large.

h. Ventral fins well separated, rather long *Bassogigas*, 10

gg. Preopercle with 2 spines; head extremely scaly *Watasca*, 11

- g*. Preopercle with 3 spines; head naked anteriorly. *Hoplobrotula*, 12
ff. Lateral line represented by three rows of pores, dorsal, lateral, and
ventral; head with numerous spines and mucous pores; opercular
spine straight *Porogadus*, 13
cc. Pectoral with the lower rays free, produced beyond the upper; preopercle
with 3 spines; ventrals simple, well separated *Pteroidonus*, 14

7. BROTULA Cuvier.

Brotula CUVIER, Règne Animal, 2d ed., II, 1829, p. 296 (*barbata*).

Body elongate, compressed, covered with minute, smooth scales; eye moderate; mouth medium, with villiform teeth on jaws, vomer, and palatines; lower jaw included; each jaw with 3 barbels on each side. Dorsal fin long and low, the dorsal and anal joined to the caudal. Ventral fins close together, very slender, each of two rays separated at the tip. Eight branchiostegals. Air bladder large, with 2 horns posteriorly. One pyloric cæcum. Vertebrae 16 + 39 = 55. Tropical.

(*brotula*, Spanish name of *Brotula barbata*.)

7. BROTULA MULTIBARBATA Schlegel.

ITACHI-UWO (WEASEL-FISH); UMINAMAZU (SEA CAT-FISH).

Brotula multibarbata SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 251, pl. III, fig. 2; Nagasaki.—GÜNTHER, Cat. Fish., IV, 1862, p. 371; Japan, Celebes, Amboina, Buru.—ISHIKAWA, Prel. Cat., 1897, p. 26; Tokyo.—STEINDACHNER, Reise H. M. S. Aurora, 1898, p. 216; Kobe (good description).

Brotula japonica STEINDACHNER add DÖDERLEIN, Fische Japans, IV, 1887, p. 24; Tokyo.

Head, 5 (in total); depth, 4 to $4\frac{1}{2}$ (in total); D., C., and A. 186; P. 22; V. 1; B. 8; Cæc. pylor. 2; interorbital space, $\frac{2}{3}$ the eye; ventral, $\frac{2}{3}$ of head.

Body elongate, the tail very compressed and terminating in a point; swelling of trunk behind pectorals somewhat more than half the depth of the body. Head rounded above; eye equal to snout; snout with a slight projection above in front; maxillary extends to the posterior border of the eye; jaws about equal, or the lower a little shorter; a band of velvety teeth in jaws, on vomer, and on palatines; opercular margin pointed behind; operculum with a strong spine posteriorly; mandibular barbels 6, the longest about $\frac{1}{3}$ the head; 6 superior barbels, these $\frac{1}{3}$ longer than those below.

Body and head covered with small, smooth, round scales, the surface finely granulated.

Dorsal, anal, and caudal continuous, and the last terminating in a rounded point; the origin of the dorsal is about over that of the pectoral; pectorals inferior, rounded, hardly half the head; ventrals close together, of 2 filaments united, the inner $\frac{1}{3}$ shorter than the outer. Vent in about $\frac{2}{3}$ the total length. Lateral line superior, with a distinct curve anteriorly.

General color when fresh reddish brown; abdomen paler; pectorals olivaceous; all the fins bordered with whitish; lips, barbels, and ventrals somewhat reddish; iris grayish. Shimabara. (Schlegel.)

This species is apparently rare in Japan; no specimens being found in our collections. It was described by Schlegel from Shimabara, near Nagasaki, by Döderlein from off Tokyo, and by Steindachner from Kobe.

(*multum*, many; *barbatus*, bearded.)

8. MYXOCEPHALUS Steindachner and Döderlein.

Myxcephalus STEINDACHNER and DÖDERLEIN, *Fische Japans*, IV, 1887, p. 25. (*japonicus*).

Body short, rather deep, greatly compressed, and ending in a point behind; covered with moderate-sized, smooth, and elongate scales. Head very large, broad, thick, rounded, without scales, covered with soft loose skin beset with small, short, shred-like filaments or papillæ; the bones with large mucous cavities opening by pores. Eye small, mouth rather large; teeth villiform on vomer, palatines, and in jaws; no barbels; preopercle unarmed; opercle with a spine. Gill-openings very large and the membranes narrowly free over the isthmus. Dorsal and anal in a broad basal membrane in front. Ventrals close together below opercles, each of a single ray. Lateral line arched till over vent, then straight to the base of the caudal. No pyloric cæca. Pseudobranchiæ rudimentary or absent.

(*μύξος*, mullet; *κεφάλῃ*, head.)

8. MYXOCEPHALUS JAPONICUS Steindachner and Döderlein.

ITACHI (MINK OR WEASEL).

Myxcephalus japonicus STEINDACHNER and DÖDERLEIN, *Fische Japans*, IV, 1887, p. 25; off Tokyo.

Head $3\frac{3}{4}$; depth about 4; D. 134; A. 100; P. 31; V. 1; greatest depth of body $1\frac{1}{2}$ in the head; breadth of head $1\frac{1}{4}$; depth of head about $1\frac{1}{4}$; interorbital space, 3; width of mouth, $2\frac{3}{8}$; maxillary, $2\frac{1}{2}$; snout 5; eye 7; eye, $1\frac{1}{2}$ in snout, 3 in maxillary, $2\frac{1}{2}$ in interorbital space; pectoral $1\frac{1}{2}$ in head; ventral, 2.

Body greatly compressed, rather short and deep, the tail tapering to a point. Head very large, broad, thick, and oblong; snout very blunt, obtuse, broad, and rounded above; eye small, lateral, its posterior margin at the first third of the head; preorbital and infra-orbitals broad; posterior nostrils large, directly in front of the eye; anterior nostrils in a large tube near the tip of the snout; a large pore exterior to the anterior nostrils on each side, another on each side of the head above; gill-rakers large, thick, more or less variable and about $\frac{5}{6}$; a slit after the fourth gill-arch.

Head naked, the rest of the body covered with elongate smooth cycloid scales. Along the bases of the dorsal and anal anteriorly a rather thin broad membrane concealing the bases of the fin rays.

Dorsal originating a little behind the base of the pectoral, confluent with the anal and caudal, the latter terminating in a sharp point; pectoral long, its base thick, broad, and the middle rays forming a blunt angle; nostrils close together and situated a little posterior to the posterior margin of the preoperculum. Lateral line high in front, curved till about over the vent, when it runs medianly along the sides to the base of the caudal.

Color in alcohol uniform dark brown; pectorals, dorsal, caudal, anal, and inside of gill-opening black; the filaments on the head blackish; lower surface of the head slightly pale.

Total length, $15\frac{3}{4}$ inches (400 millimeters).

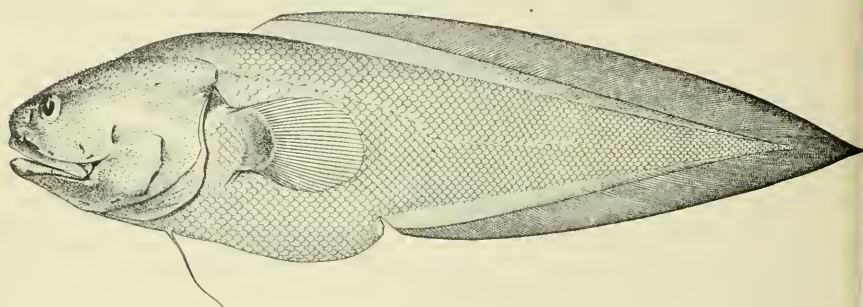


FIG. 5.—MYXOCEPHALUS JAPONICUS.

This species is known to us from the specimen described above, collected at Uraga, near Misaki, by Capt. Alan Owston. It differs from Steindachner's description somewhat, especially in the presence of rudimentary or small pseudobranchiae, slightly broader head, and greater number of fin rays.

9. SIREMBO Bleeker.

Sirembo BLEEKER, Act. Soc. Sci. Indo. Nederl., III, Japan, IV, 1858, p. 22 (*imberbis*).

Brotella KAUP, Wiegmann's Archiv, 1858, p. 92 (*imberbis*).

Body elongate, covered with very small scales. Lateral line simple, well developed anteriorly, indistinct behind. Eye moderate, vertical fins united; ventral fins each reduced to a single filament, the two inserted close together, on the humeral symphysis. Jaws, vomer, and palatines with bands of villiform teeth. Lower jaw included. Snout without barbels. Air-bladder present. Preopercle unarmed; opercle with spines. Shore fishes of Japan.

(Name unexplained.)

9. SIREMBO IMBERBIS Schlegel.

UMIDOJO (SEA LOACH).

Brotula imberbis SCHLEGEL, Fauna Japonica, Poiss., 1847, pl. 253, p. III, fig. 3; Nagasaki.

Sirembo imberbis BLEEKER, Act. Soc. Sci. Indo Nederl., III, 1857, Japan, IV, p. 22.

Head $4\frac{1}{2}$; depth $5\frac{3}{4}$; D. about 90; A. about 67; P. 22; V. 1; depth of body $1\frac{1}{2}$ in head; eye 4 in head, 2 in maxillary; snout 5 in head, $2\frac{1}{2}$ in maxillary; pectoral $1\frac{1}{2}$ in head; ventrals $1\frac{1}{2}$; head 1 in trunk; head and trunk about $1\frac{1}{2}$ in tail.

Body oblong, greatly compressed, and the tail tapering to a point. Head oblong, compressed; snout truncate, rounded, blunt, less than the eye; eye superior, somewhat elongate, its posterior margin much nearer the snout than the gill-opening; mouth large, the maxillary expanded and reaching a little beyond the eye; expanded extremity of maxillary with its posterior edge concave and its breadth at this point about two-thirds the eye; nostrils lateral, in front of eye on the snout; interorbital space a little less than eye, and almost flat; teeth in villiform bands in the jaws and on vomer and palatines; tongue very thick, pointed, and little free in front; infraorbital rather narrow; lips rather fleshy. Gill-openings large, the membranes not united, and the isthmus narrow; pseudobranchiae rather small; gill-rakers 5 + 15, and only those on the upper part of the arch below the bend elongated and thick, the others small, rounded, and rudimentary.

The body covered with rather large, round scales. Head almost entirely scaled.

Dorsal beginning behind the pectoral and, like the anal, rather high; dorsal, anal, and caudal confluent, the latter ending in a sharp point; pectoral rather broad, pointed behind; ventrals jugular, each of a single ray and with their bases close together below the posterior part of the eye. Lateral line superior and concurrent with the back to the base of the caudal.

Color in alcohol brown, darker above, paler beneath, and silvery; opercles with a dark spot; pale longitudinal stripes on the sides, the first from the snout across the upper part of the eye, so that a dark stripe runs below this through the eye, then below this latter another white stripe from the base of the pectoral above, and, finally, below this another darker one, which is indistinct; along the base of the dorsal are a number of dark-brown blotches, and another series is also seen along the lateral line; bases of dorsal, anal, and caudal very pale; dorsal margined broadly with blackish, the tail grayish, the anal with a narrow white border, and also with a blackish marginal longitudinal band; pectorals and ventrals pale.

Length $9\frac{1}{6}$ inches (230 millimeters).

Described from Nagasaki examples.

This species occurs at moderate depths and is common in southern Japan. Our numerous specimens are from Tokyo, Misaki, Wakanoura, and Nagasaki. At Nagasaki it is especially abundant, and is by no means a deep-water fish.

(*imberbis*, beardless.)

10. BASSOGIGAS Gill.

Bassogigas GILL, in Goode and Bean, Oceanic Ichthyology, 1895, p. 329 (*grandis*).

Body elongate, compressed, covered with thick, heavy skin, which obscures all the angles of the skull. Scales small, covering the head completely. Lateral line indistinct behind. Eye moderate. Vertical fins united about the tail; ventral fins well separated, each one a bifid filament. Snout slightly produced, without barbels, the lower jaw slightly included. Villiform teeth on jaws, vomer, and palatines, the vomerine patch V-shaped. Opercle with a long sharp spine; preopercle unarmed. Air bladder present; pseudobranchiæ small. Deep seas, both Atlantic and Pacific.

(*βασσός*, deep sea; *γίγας*, giant.)

10. BASSOGIGAS GRANDIS Günther.

Sirenbo grandis GÜNTHER, Ann. Mag. Nat. Hist., XX, 1877, p. 437; near Yokohama in deep water.

Neobrythites grandis GÜNTHER, Deep Sea Fishes, Challenger, p. 100, pl. XXI, fig. A; near Yokohama.

Head rather short and broad, with obtuse snout overlapping the lower jaw; eye small, about $\frac{1}{2}$ the length of snout and $\frac{1}{11}$ the head; mouth rather wide, the maxillary extending to behind the eye; barbels none; teeth of jaws, vomer, and palatines in villiform bands; vomerine teeth form a triangular patch much broader than long; width of palatine band exceeds that of intermaxillary; a deep groove in the skin descends from the anterior nostril toward the maxillary and reascends toward the median line of the extremity of the snout, cutting off an anterior lobe as in some sciaenoids; several pores leading into the muciferous system are hidden in the groove; a few small open pores near the symphysis of the mandible; nostrils gaping, oval openings, of which the anterior is surrounded by a membranous wall; preoperculum crescent shaped, without any armature; operculum with a strong spine above.

Scales minute; also the entire head, even the space between the nostrils, covered with minute scales.

Dorsal, like the anal, enveloped in a thick, scaly skin; it begins with short rays above the middle of the pectoral; pectoral rounded, broad, and remarkably short, about half as long as the head; ventrals inserted below the angle of the preoperculum: each ventral filament is bifid, the inner part being the longer; distance of vent from root of pectoral

more than the length of the head. Lateral line indistinct for the greater part of the course.

Color brown, darker behind, lighter in front; fins blackish, cavity of mouth gray, peritoneum black. Total length $29\frac{1}{2}$ inches; head $5\frac{3}{4}$ inches; ventral filament 3 inches; snout to vent $12\frac{1}{2}$ inches.

Locality, south of Tokyo, near Yokohama, at Station 237 (Challenger) in 1,875 fathoms. (Günther.) Not taken by us.

(*Grandis*, great.)

11. WATASEA Jordan and Snyder.

Watasea JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 765 (*sivicola*).

Body elongate and completely covered with small scales. Head scaled, blunt; eye moderate; the jaws equal; no barbels; teeth in jaws, vomer, and palatines minute, blunt, and in bands; preopercle with two spines; vertical fins united, the caudal pointed; pectorals acutely rounded; ventrals close together, each of two rays; eight branchiostegals.

(Named for Sho Watase, professor of Animal Morphology in the Imperial University of Tokyo.)

11. WATASEA SIVICOLA Jordan and Snyder.

Watasea sivicola JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 765, pl. XXXVII; Misaki, Yokohama.

Head, $4\frac{3}{4}$; depth, $5\frac{3}{4}$; D. 94; A. 74; scales in lateral line about 100; scales between middle of base of dorsal and lateral line, 8; between origin of dorsal and lateral line, 11; between lateral line and anal, about 25; head as long as trunk; head and trunk, $1\frac{2}{3}$ in tail; depth of body, $1\frac{1}{8}$ in head; eye, $4\frac{3}{4}$; snout, 6; maxillary, 2; interorbital space, $4\frac{2}{3}$; width of head at maxillaries, $2\frac{1}{5}$; pectoral, $1\frac{3}{5}$; ventral, $1\frac{1}{3}$.

Body elongate, greatly compressed, its greatest width much less than the breadth of the head, and tapering into a pointed tail. Head oblong, compressed; snout very blunt, truncate; jaws equal; eyes small, elongate, lateral, and its posterior margin about the first $\frac{2}{3}$ of the head; maxillary very large, extending far beyond the eye, and its distal expanded moiety $1\frac{1}{3}$ in the eye, and its posterior margin concave; supplemental maxillary well developed and concealed by the infraorbitals, which are much less than the eye diameter; teeth in jaws, on vomer and palatines in broad villiform bands; lips thin; tongue rather broad, thick, pointed, and little free in front; nostrils rather large and the posterior the larger; upper profile straight from snout to occiput; preoperculum with 2 strong, broad, sharp spines pointed back; opercle with a strong spine above, directed backward and slightly inclined downward; head with mucous cavities and pores; interorbital space convex, its width much greater than snout. Gill-opening very large,

the isthmus narrow, and the membrane joined to it under the eye; a band of villiform teeth along the floor of the pharynx, beginning on the tongue and the pharyngobranchials above, forming a toothed area posteriorly similar to those below; pseudobranchiæ small; gill-rakers 5 + 11 on first arch, somewhat thick, blunt, and long; branchiostegals, 8.

Head and body covered with elongated, smooth, cycloid scales; bases of pectoral and dorsal rays with small scales.

Dorsal, anal, and caudal confluent, the latter ending in a point; the membrane at base of the fins not fleshy; dorsal beginning about $\frac{1}{4}$ the length of the head from its posterior end; pectoral short, pointed, and only reaching about $\frac{3}{8}$ the space between its own origin and the vent; ventrals only separated by a narrow space, inserted about midway between the posterior edge of maxillary and tip of lower preopercular spine; the inner filament the longer and reaching midway in the space between its base and the vent, the undivided basal portions of ventrals equal to $1\frac{1}{3}$ eye diameters. Lateral line running along the upper third of the body and disappearing at a point about $\frac{1}{2}$ the length of the head from the base of the caudal.

Color in alcohol plumbeous gray, and more or less silvery below.

Length, $9\frac{3}{16}$ inches (234 millimeters).

This description from the type No. 6375, Ichthyological Collections, Leland Stanford Junior University Museum. Locality, Misaki, in Sagami. Taken in deep water.

Another is in the U. S. National Museum (No. 49707), taken by Mr. P. L. Jouy off Yokohama.

(*Kuro Shiro*, the Black Current, *colo*, to inhabit.)

12. HOPLOBROTULA Gill.

Hoplobrotula Gill, Proc. Ac. Nat. Sci. Phila., 1863, p. 253 (*armata*).

This genus differs from *Watassea* and *Sirembo* in having three strong spines on the preopercle. Maxillary and anterior parts of head naked; posterior upper part of maxillary free from the suborbital; ventral fins bifid; lateral line simple; well developed anteriorly.

(ὄπλον, armature; *Brotula*.)

12. HOPLOBROTULA ARMATA (Schlegel).

Brotula armata SCHLEGEL, Fauna Japonica, 1847, p. 255; Nagasaki.

Sirembo armata STEINDACHNER and DÖDERLEIN, Fische Japans, IV, 1887, p. 24; Tokyo.

Hoplobrotula armata JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 767, pl. XXXVIII; Nanaura in Boshu.

Head, $4\frac{2}{3}$; depth, $5\frac{1}{4}$; D., 86; A., 74; P., 23; V., 2; scales in lateral series, 112; scales between base of dorsal and lateral line, 9; scales between lateral line and anal, 27; head and trunk, $1\frac{1}{2}$ in tail; depth of head, $1\frac{1}{3}$ in its length; width of head, $1\frac{3}{4}$ in its length; eye, 5 in head;

snout, $4\frac{1}{6}$; maxillary, 2; interorbital space, 4; width of mouth at maxillaries, $1\frac{1}{4}$; pectoral, $1\frac{2}{3}$; ventrals, $1\frac{2}{3}$.

Body elongate, greatly compressed, its greatest width much less than the breadth of the head, and tapering into a pointed tail. Head oblong, compressed; snout very blunt, truncate; jaws equal; eye small, elongate, lateral and its posterior margin about the first $\frac{2}{5}$ of the length of the head; maxillary very large, extending far beyond eye, its distal expanded moiety equal to snout, and the posterior edge slightly emarginate: supplemental maxillary well developed and not entirely slipping under the infraorbitals, which are not as broad as the eye diameter; teeth in rather broad, rough, villiform bands on vomer and palatines and in the jaws; lips fleshy and more or less papillose or shredded; tongue very broad, thick, pointed, and hardly free in front; nostrils in front of eye; upper profile straight from snout to occiput; preoperculum with 3 strong spines protruding through the skin, the lower one pointing downward and the other 2 pointing downward and backward; opercle with a strong spine above, bent down and backward; a number of mucous pores on head, several on opercles above, on the mandible, orbitals, and 2 large ones at the edge of the snout in front of nostrils; interorbital space convex, its width equal to snout. Gill-opening very large, the isthmus long and narrow, and the membrane thick, united directly below front of eye; a toothed area extending from near tip of tongue to posterior part of pharynx, the roof of which is furnished with a toothed surface similar to those of the jaws; pseudobranchiae very small; gill-rakers 5 + 16, thick, short, those of the upper limb and all but 5 of the lower reduced to mere rounded elevations, the other short and flat; branchiostegals, 8.

Head naked, except opercles, the sides of head above, and preopercles, which are covered with rather large cycloid scales; scales on body similar, becoming elongated at the end of the tail.

Dorsal, anal, and caudal confluent, the latter ending in a point; the membrane at base of the fins rather fleshy; dorsal beginning above over the first third of pectoral, or at a distance behind head equal to one-fourth the latter's length; pectoral long, pointed, and reaching vent; ventrals divided to within a short distance of their base, the remaining basal space not divided equal to an eye in diameter; the inner ventral ray the longest and not quite to the base of pectoral; the ventrals are inserted below the anterior portion of the eye. Lateral line superior, approaching nearer to the back posteriorly, and becoming obsolete at a distance from the tip of the caudal equal to three-fourths the length of the head.

Color in alcohol uniform pale brown overlaid with silvery, the dorsal and anal becoming deep brown posteriorly like the caudal, which is entirely the same color.

Length, 15½ inches (403 millimeters).

This description from the specimen described by Jordan and Snyder, obtained at Nanaura, in Boshu, near Misaki, and presented by the Imperial University of Japan to the Stanford University Collection. (*armatus*, armed.)

13. POROGADUS Goode and Bean.

Porogadus GOODE and BEAN, Proc. U. S. Nat. Mus., VIII, 1885, p. 602 (*miles*).

Body brotuliform, much compressed; head with numerous spines on interorbital space, 2 pairs on the shoulders, 1 at angle of operculum, and a double series on angle of preoperculum; head with numerous mucous pores, as in *Bassozetus*; mouth large; snout moderate, not projecting much beyond the upper jaw; jaws nearly equal in front; teeth in villiform bands in jaws and on vomer and palatines; barbel none; gill-openings wide, membranes narrowly united, not attached to the isthmus; gills 4; gill laminae short; gill-rakers moderate, numerous; pseudobranchiae absent; caudal fin of few rays, on a very narrow base, not prolonged, scarcely differentiated from the vertical fins; dorsal and anal fins well developed; pectorals simple, moderate; each ventral a single bifid ray close to the humeral symphysis; branchiostegals 8; scales small; lateral line apparently triple or replaced by 3 series of pores—1 close to ventral outline, 1 median, and another along base of dorsal.

(πόρος, pore; *Gadus*, the cod fish.)

13. POROGADUS GÜNTHERI Jordan and Fowler, new species.

Head, 6¾; depth, 11¾; head and trunk, 3¾ in tail; depth of body, 1¾ in head; eye, 6; snout, 3¾; maxillary, 1¾; interorbital space, 3¼; width between maxillaries, 2¾; pectoral, 1¼; ventral, 1¾.

Body very elongate, compressed so that it is not as broad as the head, and gradually tapering posteriorly into a long, slender tail. Head about equal to trunk, compressed, oblong; snout broad, convex above, and much greater than eye; eye lateral, its position much before middle of head; jaws equal, mouth broad, the maxillary expanded distally, its posterior edge concave, and equal to the eye, and projecting far beyond; supplemental maxillary well developed and not concealed by the orbitals; teeth in narrow, villiform bands in jaws, on vomer, and on palatines; lips thin; tongue small, thick, pointed, and free in front; anterior nostrils not evident, the posterior very large, in front of eye; upper profile straight from snout to occiput; head with many spines; opercular spine sharp; gill-opening very large, the membrane narrowly free over the narrow isthmus; a narrow median band of villiform teeth along the floor of the pharynx and the roof also with an area of villiform teeth; pseudobranchiae reduced to 2

small filaments; gill-rakers, 5+24 on the first arch and only 19 on the lower part of the arch, long, attenuated, and well developed; branchiostegals, 8.

Head and body covered with small, smooth cycloid scales, perhaps 200 in a lateral series.

Dorsal, anal, and caudal confluent, the latter ending in a point; the dorsal beginning a little behind the base of pectoral; pectoral small, pointed, and reaching more than half the distance in space between its base and vent; ventrals close together, each of two filaments and inserted below the head nearer the base of the pectoral than the extremity of the maxillary; undivided basal portion of the ventrals equal to two-thirds the eye. Lateral lines of large pores rather widely separated, running along the base of the dorsal, the sides medianly, the sides of the abdomen, and the base of the anal below.

Color in alcohol for the greater part brown, the sides and lower part of the head together with the abdomen black; top of the head, snout and orbital region gray-white.

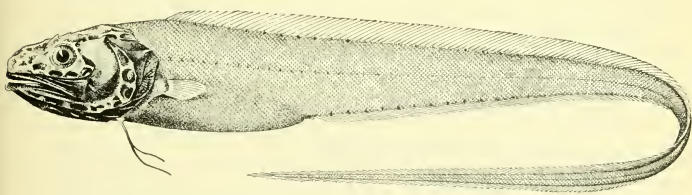


FIG. 6.—POROGADUS GÜNTHERI.

Length, $8\frac{5}{8}$ inches (211 millimeters).

Type.—No. 50577, U. S. National Museum.

Locality in Sagami Bay, at Station No. 3696, where it was dredged in 501 to 749 fathoms by the U. S. Fish Commission steamer *Albatross*.

Cotypes No. 7124 are in the Ichthyological Collections, Leland Stanford Junior University

(Named for Dr. Albert Günther.)

14. PTEROIDONUS Günther.

Pteroidonus GÜNTHER, Deep-Sea Fishes Challenger, 1887, p. 106 (*quinquarius*).

Body elongate, compressed, covered with small scales. Head oblong, thick, covered with scales; eye small; snout broad, with rounded profile, including lower jaw, and without barbel; mouth wide, bands of villiform teeth in the jaws, on vomer, and palatines; operculum with a straight spine; preoperculum armed. Eight branchiostegals; gill-laminae rather short; gill rakers rather long, lanceolate, and widely set; pseudobranchiae none. Vertical fins united, but the narrow caudal

projecting beyond the short anal and dorsal rays; the lower pectoral rays are incompletely united with the upper part of the fin and are prolonged; ventrals reduced to a simple filament, inserted behind the humeral symphysis, and somewhat distant from each other. Lateral line incomplete, close to the dorsal profile. A true deep-sea form.

(*Pterois, Onus.*)

14. PTEROIDONUS QUINQUARIUS Günther.

Pteroidonus quinquarius GÜNTHER, Deep-Sea Fishes Challenger, 1887, p. 106; Deep Sea of Japan, Station 235, 565 fathoms.

D. 99; A. 87; P. 15-5; V. 1; C. 5; B. 8; 35 scales transversely above vent; eye, 7 in head; caudal, $7\frac{1}{2}$.

Body elongate, compressed, its depth being less than the length of the head, which equals the distance between the vent and the root of the pectoral fin. Head not much deeper than broad, its depth equal to the length of its postorbital portion and flat above; eye small, without orbital fold, much shorter than snout, lateral, and situated immediately below the upper profile of the head; no spines about orbit; snout broad, rather depressed, overlapping the lower jaw; mouth wide, somewhat oblique, the much-dilated posterior extremity of the maxillary extending backward beyond the orbit; preorbital region narrow, inframaxillary styliform; teeth in villiform bands, the bands of the vomer and palatines very narrow; vomerine band \wedge -shaped; nostrils rather distant from each other, open, the posterior the larger, immediately in front of the upper part of the eye, the anterior close to the end of the snout; the interorbital space more than twice the eye; preoperculum with a rounded angle which is armed with 3 very short and weak spines; opercular spine moderately strong and straight; the bones of the head are thin, with shallow muciferous cavities. Gill-membranes entirely separate.

Nearly the entire head, even the dilated extremity of the maxillary and the glossohyal region, are covered with small scales; the scales are small, thin, smooth, and adherent.

Dorsal begins a short distance behind root of pectoral, rather low, the rays inclosed in a scaly skin at base, and has its last and shortest rays connected with caudal by a membrane; anal similar to dorsal but lower; pectoral with broad base, elongate, posterior margin rounded, and as long as head without snout; the 5 detached rays are somewhat stronger than the other rays; they form at the base one continuous series with the remainder of the fin, and therefore do not seem to possess a separate action; the uppermost ray is the longest, not quite twice as long as the fin, the others gradually decreasing in length; ventrals very feeble simple filaments, only half as long as the pectoral, somewhat distant from each other and inserted opposite to the hind margin of the preoperculum; the tail tapers almost to a point. The

lateral line is a continuous tract not covered by scales, running parallel to and close to the dorsal profile and disappearing in the posterior third of the tail; it is separated from the dorsal fin by about six series of scales.

The color was probably pink, with black vertical fins; cavity of the mouth and gills black.

Length, $14\frac{1}{2}$ inches.

Locality, Challenger Station 235, at a depth of 565 fathoms. Japan. (Günther.)

Not seen by us.

(*quinquarius*, in fives.)

SUMMARY.

Family I. CONGROGADIDÆ.

1. *Hierichthys* Jordan and Fowler.

1. *eucryptes* Jordan and Fowler; Miyakoshima.

Family II. ZOARCIDÆ.

2. *Zoarces* Cuvier.

2. *elongatus* Kner; Iwani, Hakodate, Sagalin, Tishima.

3. *Lycenchelys* Gill.

3. *parcilimon* Jordan and Fowler; Matsushima Bay.

4. *Bothrocara* Bean.

4. *zesta* Jordan and Fowler; Sagami Bay.

Family III. CARAPIDÆ.

5. *Carapus* Rafinesque (*Fierasfer* Cuvier).

5. *kagoshimanus* (Steindachner and Döderlein).

Family IV. OPHIDIIDÆ.

6. *Otophidium* Gill.

6. *asiro* Jordan and Fowler; Misaki.

Family V. BROTLIDÆ.

7. *Brotula* Cuvier.

7. *multibarbata* Schlegel; Formosa.

8. *Myxoccephalus* Steindachner and Döderlein.

8. *japonicus* Steindachner and Döderlein.

9. *Sirembo* Bleeker.

9. *imberbis* (Schlegel); Tokyo, Misaki, Wakanoura, Nagasaki.

10. *Bassogigas* Gill.

10. *grandis* Günther.

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11. *Watasea* Jordan and Snyder.
11. *sivicola* Jordan and Snyder; Misaki, Yokohama.
12. *Hoplobrotula* Gill.
12. *armata* (Schlegel); Nanaura.
13. *Porogadus* Goode and Bean.
13. *güntheri* Jordan and Fowler; Sagami Bay.
14. *Pteroidomus* Günther.
14. *quinquarius* Günther.

A REVISION OF THE AMERICAN MOTHS OF THE FAMILY
GELECHIIDÆ, WITH DESCRIPTIONS OF NEW SPECIES.

By AUGUST BUSCK.

U. S. Department of Agriculture.

Since Dr. C. V. Riley's List of *Tineina*¹ nothing has been published on this group in America except isolated descriptions of single species and their life histories.

Dr. Riley followed the classification generally in use at that time, founded on Stainton's and Heinemann's works, although Edward Meyrick² previously had published his masterly rearrangement of the group based on natural evolutionary lines, a work which, as Lord Walsingham has said,³ after the fuller exploitation of the system in the Handbook of British Lepidoptera, "marks an epoch in the study of these insects."

Since then the views of Meyrick have been generally adopted and great strides have been made by European specialists in the study of these insects. A much more satisfactory appreciation of the value and relationship of the genera and families now prevails than was formerly the case.

The following arrangement of the American Gelechiidæ consists in the application to the American fauna of the results of these advanced studies.

In this work I have been greatly assisted by Mr. Edward Meyrick. Numerous concrete questions have been made clear for me by his valuable assistance, which he has most liberally and untiringly extended.

Much kind help also has been received from Lord Walsingham and Mr. John Hartley Durrant, whose large collections and intimate knowledge of the American forms made their aid particularly valuable.

Without the previous work and the liberal help and encouragement from these authorities in England my task would have been much more difficult, if not an impossible one.

As a basis for this paper I have examined all the authentic material of former workers which is still in existence on this side of the Atlantic, together with much new material.

¹In J. B. Smith's List Lep. Bor. Am., 1891.

²Trans. Ent. Soc., London, 1883.

³Proc. Zool. Soc., London, 1897.

From Miss Mary Murtfeldt, the Nestor among students in this group in America, I have received not only material but also much interesting information, which no one else could have supplied, particularly concerning some of Chambers' species.

To Prof. C. H. Fernald and to Dr. William G. Dietz I am under obligation for allowing me to study their collections in their homes, also for various suggestions and for specimens.

Professor Fernald's collection included that of Miss Murtfeldt, with her types and many of the types of Chambers and of Lord Walsingham. Of especial value were those specimens furnished with Lord Walsingham's blue labels, which were passed upon by him in 1882.¹ A notebook in Lord Walsingham's handwriting, with notes and determinations, corresponding to the numbers on these blue labels, was loaned me by Professor Fernald, thus enabling me also to verify identifications of many specimens in the Museum of Comparative Zoology, Cambridge, Massachusetts, especially those which formerly belonged to the Peabody Academy of Science, in Salem, Massachusetts.

Dr. Dietz's collection contained his types and several specimens named by Lord Walsingham.

The collection in the museum in Cambridge contains nearly all of Zeller's types and a great many of Chambers', besides the specimens named by Lord Walsingham. This collection proved the richest of any in authentic specimens, and although careful discrimination was necessary among Chambers' types, many species were identified here which would otherwise have remained unknown to me. I am indebted to Mr. Samuel Henshaw for much courtesy and information given me during my stay in Cambridge, as well as for sending me many specimens needed for reexamination after my return to Washington.

The collection of the Philadelphia Academy of Natural Sciences has unfortunately but a few of Clemens' types left. There are, however, some types and specimens named by Lord Walsingham. To the curator, Dr. H. Skinner, I owe thanks for giving me every facility for examining the collection and manuscripts.

The Belanger collection, formerly in the Laval University, Quebec, containing Chambers' types of Canadian *Tineina*, was obtained by the writer through the courtesy of the present curator, Rev. Dr. C. E. Dionne, and is now in the U. S. National Museum.

What little was left of the late Mr. William Saunders' collection of *Tineina*, consisting of fragments of some of Chambers' types, was secured, together with some new Canadian material for the U. S. National Museum, through the kind agency of Dr. J. Fletcher, Ottawa, Canada.

From Mr. William D. Kearfott I received for study a well-pre-

¹Trans. Am. Ent. Soc., Phila., X, 165-204.

served collection of about 800 unnamed American Gelechiidæ with the most liberal permission to retain desired specimens.

Smaller collections, on similar liberal conditions, have been received from Mr. Nathan Banks and through Dr. Harrison G. Dyar from Dr. W. Barnes and Prof. C. P. Gillette.

Rev. Dr. Fyles has kindly sent me certain specimens and information.

Finally and principally, there was the collection in the U. S. National Museum, which contains many types of Riley, Murtfeldt, Walsingham, Chambers, and Zeller, besides a great many specimens determined by Lord Walsingham and Mr. William Beutenmüller, together with a considerable number of bred or collected miscellaneous specimens, including the collections of Dr. H. G. Dyar, in Florida, Colorado, and elsewhere; of Mr. E. A. Schwarz, in Texas, Arizona, and Colorado; of Prof. T. D. A. Cockerell, in New Mexico; of Messrs. Coquillett and Koebele, in California; and fine series of many species, with notes, bred during many years in the insectary of the United States Department of Agriculture, largely by Mr. Th. Pergande. The Museum also contains Dr. Ottmar Hofmann's large collection of excellently mounted specimens of European species, authentically determined, which naturally has proved of very valuable assistance.

Mr. Coquillett has kindly given me his private notes on some of his bred specimens. These are credited under the species.

To Dr. Harrison G. Dyar I owe much gratitude for the continued interest and encouragement given me during my studies, as well as for actual help, and last, but not least, for aid in reading and correcting this manuscript and proofs.

The purpose of the present paper is not to present an exhaustive monographical treatise on American Gelechiidæ. The group is not well enough known as yet for such treatment. It is rather a revision of what has already been done, so that future work may proceed on a sounder foundation.

The genus *Gelechia* has been for former workers much as Chambers expressed it, "a waste box, a convenient receptacle for every species which could not be better disposed of."¹

Such new genera as were erected from this miscellaneous aggregation, especially those separated by Chambers, were most frequently given insufficient characterization. To study these genera critically, to substantiate and define more fully those which were found tenable, and to eliminate those erected on superficial characters, and then to place as far as possible the described species where they belong has been the principal object of the writer.

For this reason I have described only about 50 new species, such as

¹Can. Ent., IX, p. 231.

had been either bred or belonged to some specially interesting group or were so commonly received for determination as to make a name for them desirable.

If my purpose had been to describe new species, four times as many could as easily have been found in the material at my disposal, but it was believed that the ultimate benefit to science would be better served by leaving these many species unnamed until they have been bred or at least had been obtained in larger and more well-preserved series than we have at present.

Of the 43 genera included in the family Gelechiidae in Riley's list, 21 have been removed to other families and 8 more have been found to be synonyms of other genera; while, on the other hand, one genus has been recovered from another family in Riley's list, 5 old genera of American authors have been resurrected, 9 genera from other faunas have been identified in America, and 6 new genera have been added, of which 3 are described in the present paper, thus making 35 genera now recognized as North American.

In Riley's list the genus *Gelechia* contained the large number of 213 species, not counting most of Walker's species and some others which were omitted. The number has now been reduced to less than 100, and of these 54 remain in the genus only because they are unrecognized, and they are therefore liable to be removed to some other genera when identified. These unrecognized species are the great drawback to work in this group. The types and all authentic material of most of them are lost, and the descriptions furnish no clew to their proper genera, rendering recognition very difficult and uncertain. Still several of them may be rediscovered, especially by diligent search in Chambers' old collecting grounds in Kentucky, from where, practically, no material has been received since his death.¹

The collections of the British Museum remain to be studied; there should be found the types of Walker's unrecognized species, as well as some of Clemens', which he sent to Stainton forty years ago.

The family Gelechiidae as defined by Meyrick and as used in this paper comprises moths with the following characters: Head smooth or at most slightly ruffled. Antennae simple or slightly serrate, rarely ciliate, in a single American genus with pecten on the basal joint. Labial palpi long, curved, ascending; terminal joint usually acutely pointed. Maxillary palpi obsolete or very small, appressed. Posterior tibiae more or less rough haired above.

Forewings normally with 12 veins, sometimes with only 11 or 10 by coincidence of veins; 7 and 8 normally stalked, sometimes coincident;

¹The writer has, since this was written, been so fortunate to have a short but strenuous collecting period in this locality, securing much valuable material of Tineina, among which, however, were strangely few Gelechiidae. It is hoped that in the future the active cooperation of local entomologists may be counted on.

7 to costa; vein 1b furcate at base. Hindwings normally with 8 veins, exceptionally with only 7 or 6 by veins 6 and 5 being obsolete; vein 8 more or less distinctly connected with the cell by a cross vein. The form of the hindwing is more or less trapezoidal, termen is usually sinuate or emarginate below apex.

This last character is always diagnostic when present, as it is not found outside of this family. In the few more generalized genera, where the termen is not sinuate, veins 7 and 6 in the hindwings are approximate, connate, or stalked, thereby differing from the nearest allied family *Oecophoridae*.¹

The larvæ of Gelechiidæ exhibit great differences in coloration and habits. Normally they have three pairs of thoracic feet, five pairs of abdominal prolegs, and feed in folded or spun leaves or shoots or in stems or seed heads. Less commonly they are leaf miners.

They spin a cocoon, and the pupa does not protrude when the imago emerges. The pupa has segments 9–11 free.

In separating the genera in the Gelechiidæ the wing venation and the characters of the labial palpi are especially employed; of these the former is by far the most important.

While differently modified palpi and other external characters, as modifications of the antennæ, the presence or absence of raised scales, or hair pencils of different forms, may indicate generic differences, they are far less reliable than the venation, and only to be taken into consideration in connection with it.

These external characters are more apt to be modified by changed life habits or other influences in the adaptation to environments, but the venation will only undergo changes slowly through a long period of evolution, and is consequently more important in the determination of genera. This is strikingly illustrated by finding the identical characteristic tufted palpi in different families; in *Ypsolophus* and *Leuce* in the Gelechiidæ, in *Eumeyrickia* in the Oecophoridae, and in *Plutella* in the Plutellidæ.²

The raised scales on the forewings are found here and there in all the families, while the hair pencil in the male at the base of the hindwings, used as the sole character by Lord Walsingham to distinguish his genus *Eucatoptus* from *Aristotelia* is found in several Gelechiid genera, and is not constant within these.

Even such a specialized modification as the antennal notch found in *Glyphipdocera* and *Anorthosia* in the Gelechiidæ recurs again in the

¹As defined by Meyrick in his Handbook of British Lepidoptera.

²This might at a superficial view appear to prove just the opposite, and the palpi be claimed to be the persistent character while the venation had undergone changes; but it is very evident from the relationship, or rather lack of relationship, that this is not the case and that the tufted palpi are developed independently in the different families.

Blastobasidae and a very similar one in the genus *Bucculatrix* in the Tineidae.

The reason for these strangely recurring specializations is difficult to explain and will not be fully understood before we learn the true biological use of them, but that they do recur is sufficient proof of their secondary value as generic characters.

Thus it will be found that within the same genus the palpi may vary considerably, while the venation will be found to be very constant, at most varying in the coincidence of two veins, already long-stalked in the allied species, or the obliteration of a transverse vein, which in the related forms had a tendency to become obsolete.

Of the 35 genera now recognized in this family from North America 7 are widely distributed, cosmopolitan or nearly so; 7 others are found in Europe; 2 are recorded from Africa, and 19 have not been recognized outside of North America, including the West Indies.

They may be separated by the following synoptic table:

Forewings with veins 7 and 8 out of 6	1
Forewings with vein 6 separate or out of base of 7	11
1. Basal joint of antennæ with pecten	<i>Sitotroga</i> , p. 781
Basal joint without pecten	2
2. Forewings with one or more veins absent	3
Forewings with all veins present	4
3. Forewings with vein 11 absent	<i>Agrippa</i> , p. 789
Forewings with vein 11 present	<i>Helice</i> , p. 804
4. Hindwings with veins 3 and 4 separate	5
Hindwings with veins 3 and 4 connate or stalked	7
5. Hindwings of male with costal row of bristles	<i>Glauce</i> , p. 783
Hindwings without such row	6
6. Second joint of labial palpi with long spreading hairs	<i>Paltodora</i> , p. 775
Second joint of labial palpi merely rough-haired beneath	<i>Metzueria</i> , p. 773
7. Hindwings with vein 6 absent	<i>Eriippe</i> , p. 805
Hindwings with vein 6 present	8
8. Forewings with veins 3 and 4 stalked	<i>Trypanisma</i> , p. 815
Forewings with veins 3 and 4 not stalked	9
9. Forewings with veins 2, 3, 4, and 5 separate equidistant	<i>Epitthectis</i> , p. 816
Forewings with veins 2, 3, and 4 approximate, long; vein 2 distant, short ...	10
10. Second joint of labial palpi with long expansible tuft on inner side.	
	<i>Eucordylea</i> , p. 807
Labial palpi without such tuft	<i>Recurcaria</i> , p. 807
11. Forewings with veins 2 and 3 stalked	12
Forewings with veins 2 and 3 separate	16
12. Second joint of labial palpi with long projecting tuft	13
Labial palpi without such tuft	14
13. Tuft expansible	<i>Anorthosia</i> , p. 917
Tuft not expansible	<i>Ypsolophus</i> , p. 920
14. Hindwings narrower than forewings	<i>Strobisia</i> , p. 904
Hindwings broader than forewings	15
15. Male antennæ with deep notch near base	<i>Glyphiptocera</i> , p. 916
Male antennæ without such notch	<i>Trichotapha</i> , p. 906
16. Forewings with one or more veins absent	<i>Menesta</i> , p. 902
Forewings with all veins present	17

17. Hindwings (at least in male) bilobed	18
Hindwings not bilobed	19
18. Hindwings with vein 6 present	<i>Neodactylota</i> , p. 835
Hindwings with vein 6 absent	<i>Nealyda</i> , p. 790
19. Hindwings with a vein absent	20
Hindwings with all veins present	21
20. Hindwings with vein 6 absent	<i>Chrysopora</i> , p. 792
Hindwings with vein 5 absent	<i>Dioctona</i> , p. 837
21. Hindwings with veins 6 and 7 parallel	22
Hindwings with veins 6 and 7 approximate, connate, or stalked	27
22. Hindwings with veins 3 and 4 separate	23
Hindwings with veins 3 and 4 connate or stalked	25
23. Second joint of labial palpi with long projecting tuft	<i>Leuce</i> , p. 793
Second joint of labial palpi without such tuft	24
24. Costal margin of forewings impressed before apex	<i>Euchrysa</i> , p. 919
Costal margin of forewings normal	<i>Aristotelia</i> , p. 794
25. Hindwings of male with costal hair pencil	<i>Plithorinaca</i> , p. 821
Hindwings of male without hair pencil	26
26. Second joint of labial palpi with large divided brush; terminal joint thickened	<i>Gnorimoschemia</i> , p. 823
Second joint without divided brush; terminal joint thin	<i>Paralechia</i> , p. 820
27. Hindwings with veins 3 and 4 separate	28
Hindwings with veins 3 and 4 connate or stalked	29
28. Second joint of labial palpi with long projecting tuft	<i>Autoneda</i> , p. 782
Labial palpi without such tuft	<i>Telphusa</i> , p. 783
29. Terminal joint of labial palpi in male short, concealed	<i>Anarsia</i> , p. 928
Terminal joint long, exposed	30
30. Second joint of labial palpi rough beneath	<i>Gelechia</i> , p. 851
Second joint of labial palpi smooth	31
31. Terminal joint of labial palpi thickened, laterally compressed	<i>Prostomeus</i> , p. 837
Terminal joint slender	32
32. Hindwings with termen sinuate	33
Hindwings with termen not sinuate	<i>Anacampsis</i> , p. 844
33. Terminal joint of labial palpi shorter than second	<i>Polyhymno</i> , p. 839
Terminal joint longer than second	<i>Aprocrema</i> , p. 840

METZNERIA Zeller.

Plate XXVIII, fig. 1.

Metzneria ZELLER, Isis, 1839, p. 197.

As Lord Walsingham has shown,¹ this name should be used for the genus, which Duponchel² later named *Parasía*, under which name it is treated by Meyrick.³

This genus is defined by Meyrick as follows:

Labial palpi very long, more or less thickened with somewhat loose scales, terminal joint much shorter than second. Forewings elongate, narrow, pointed 7 and 8 out of 6. Hindwings under I, elongate-trapezoidal, apex acute, produced, termen sinuate, cilia 2; 3 and 4 remote, parallel, 5 approximated to 6, 6 and 7 somewhat approximated.

¹ Ent. Mo. Mag., XXXV, 1899, p. 199.

² Cat. Meth. Lep. Eur., 1846, p. 350.

³ Handbook British Lepidoptera, 1895, p. 570.

The genus is very near and correlated with *Paltodora* Meyrick, developed from *Aristotelia* and differing mainly in the labial palpi. This difference has proven even less marked than defined by Mr. Meyrick, by the knowledge of allied forms in the American fauna and the consequent widening of the genus *Paltodora* (p. 775).

Three species have been described as *Parasia* from America, namely:

1. *Apicistrigella* Chambers, afterwards transferred by Chambers to *Gelechia*. This species is an *Aproverema* and will be found treated under that genus (p. 840).

2. *Griseella* Chambers, afterwards transferred by Chambers to *Gelechia*. This species probably does not belong to either genus, but is at present unrecognized and will be found treated under the doubtful species of *Gelechia* (p. 890).

3. *Subsimella* Clemens. This species, which was placed with a query in *Parasia* by Clemens, and which subsequently has been retained there, can not, as the description proves, belong in this genus. It will be found treated under *Epithectis* (p. 816).

Thus the following species is the only representative of the genus *Metzneria* at present recognized from America.

METZNERIA LAPPELLA Linnæus.

Metzneria lappella STAUDINGER and REBEL, Cat. Lep. Eur., II, No. 2491, 1901.—
BUSCK, Dyar's List Amer. Lep., No. 5539, 1903.

This well-known European and Asiatic species, not hitherto recorded from America, has probably within quite recent years extended its range to this country.

Two years ago Mr. Samuel Henshaw submitted to me several specimens, which he had bred in 1899 from the heads of burdock collected in the swamps around Cambridge, Massachusetts. I had no difficulty in referring them to this species, but sent specimens to Mr. Meyrick, in England, for authoritative substantiation, and he kindly informed me that it was *lappella* Zeller.

I have also identified it in Professor Fernald's collection, bred from burdock in Ontario, Canada. In the U. S. National Museum are, besides the specimen received from Mr. Henshaw, others received from Rev. Thomas W. Fyles, Quebec, Canada, and a large series bred by the writer from heads of burdock received from Mr. Arthur Gibson, of the Department of Agriculture, Ottawa, Canada. Several larva are often found in a single head, and from a small handful of heads sent by Mr. Gibson nearly 100 moths issued.

The larva is short and thick, yellowish white, with brown head; thoracic feet small, and abdominal legs nearly obsolete.

The species overwinters as larva and does not pupate before the spring; the imago issues in May and June.

PALTODORA Meyrick

Plate XXVIII, fig. 2.

Cleodora (CURTIS), Meyrick, Handbook Brit. Lep., 1895, p. 571.

This genus is defined by Meyrick in his Handbook British Lepidoptera, 1895, as:

Second joint of labial palpi with long, rough, spreading hairs beneath, terminal as long as second. Forewing 7 and 8 out of 6. Hindwing under 1, elongate-trapezoidal, apex pointed, produced, termen emarginate, cilia 3; 3 and 4 remote, parallel, 5 nearer 6, 6 and 7 approximated.

Most of the American species differ from this definition in having terminal joint of labial palpi shorter than second joint, and veins 6 and 7 in hindwing are more properly said to be connate than approximate. In all other respects they agree absolutely, and the chief characteristics of each species are so unmistakably near to the European forms that one genus only can find justification, and the definition of the genus should be widened by the two alterations—terminal joint as long as second *or shorter*, and 6 and 7 in hindwing approximate *or connate*.

I have recognized the following 12 species, which may be separated by the table, but great care should be taken in determining the species, as they are very similar:

With white costal streak at beginning of cilia.....	1
Without such streak	7
1. Part of costal edge, white	2
Costal edge, not white.....	4
2. With white dashes in costal cilia.....	<i>magnella</i> , p. 776
Without such dashes.....	3
3. Ground color light yellowish brown.....	<i>pallidistrigella</i> , p. 776
Ground color dark brown.....	<i>canicostella</i> , p. 778
4. Head and thorax whitish.....	5
Head and thorax brown.....	6
5. Antennæ nearly unicolorous.....	<i>striatella</i> , p. 775
Antennæ sharply annulated.....	<i>ciliolineella</i> , p. 777
6. With dorsal apical white streak.....	<i>dietziella</i> , p. 777
Without such.....	<i>anteliella</i> , p. 778
7. Entire wing with white-tipped scales.....	8
No white-tipped scales or only at margins.....	9
8. Anterior wings with longitudinal ochreous streaks.....	<i>similiella</i> , p. 779
Without such streaks.....	<i>pallidella</i> , p. 780
9. Color light yellowish brown.....	<i>sabulella</i> , p. 778
Color dark ashy brown, alar exp. 16-23 mm.....	<i>tophella</i> , p. 780
Color pale umber brown, alar exp. 10-11 mm.....	<i>modesta</i> , p. 781

PALTODORA STRIATELLA Hübner.

Paltodora striatella HÜBNER, Staudinger and Rebel, Cat. Lep. Eur., II, No. 2935, 1901.—BUSCK, Dyar's List Amer. Lep., No. 5540, 1903.

Cleodora striatella WALSINGHAM, Insect Life, I, 1888, p. 82.—RILEY, Smith's List Lep. Bor. Am., No. 5516, 1891.

This European species has been recorded by Lord Walsingham from Colusa County, California. In the United States National Museum is a good series of authentic European specimens. I have met with a single specimen in the Henry Edwards collection in the American Museum of Natural History in New York, presumably from the United States but without locality label.

It feeds, according to European writers, in stems of *Tanacetum*, a weed common also in this country.

Veins 6 and 7 in hindwings are closely approximated.

PALTODORA PALLIDISTRIGELLA Chambers.

Cleodora pallidistrigella CHAMBERS, Can. Ent., VI, 1874, p. 244; U. S. Geol. Surv., Bull., IV, 1878, pp. 92, 135.—WALSINGHAM, Insect Life, I, 1888, pp. 81, 82.—RILEY, Smith's List Lep. Bor. Am., 1891, No. 5514.
Paltodora pallidistrigella BUSCK, Dyar's List Amer. Lep., 1903, No. 5541.

The type No. 467, U.S.N.M., received from Chambers and bearing a label in his handwriting, agrees well with the description and undoubtedly represents this species. This is the same specimen which Lord Walsingham had before him in 1888, and it has his blue label, No. 1184.

The white costal edge, together with the nearly perpendicular white costal streak and its light yellow color, separate it from the other species at present known; I have two other specimens beside the type agreeing exactly with this. They are like the type from Texas.

This is the species which differs most from Meyrick's definition of the genus in respect to labial palpi, the terminal joint being only half as long as second joint; veins 6 and 7 are distinctly connate.

PALTODORA MAGNELLA, new species.

Paltodora magnella Busck, Dyar's List Amer. Lep., 1903, No. 5542.

Antennæ dark brown, annulated with white. Labial palpi white, a small oblong spot on the upper and outer side of second joint dark brown, tip of terminal joint dark brown.

Face, head, and thorax white, slightly shaded with brown. Anterior wings yellowish gray, two outer thirds of costal edge white; a small black spot on fold and two elongated black white-edged dashes on the middle of the wing in continuation of each other, sometimes forming one uninterrupted black line.

From apical fourth of costa a thin oblique white line outward to termen; above this four white dashes in the costal cilia, and opposite it correspondingly a dorsal white line emitting three white pencils into the dorsal cilia; cilia whitish with three heavy black transverse lines at apex. Hindwing dark gray, cilia yellowish. Legs light brown, tarsi white, annulated with black.

Alar expanse.—15.5 to 16.5 mm.

Habitat.—Colorado.

Type.—No. 6345, U.S.N.M.

Other specimens are in Dr. Dietz's collection, where it was labeled *striatella* Hübner, from which species it differs by the white costal edge and the stronger annulation of the antennæ, besides being a much larger species.

PALTODORA CILIALINEELLA Chambers.

Gelechia cilia lineella CHAMBERS, Can. Ent., VI, 1874, p. 242; Bull. U. S. Geol. Surv., IV, 1878, pp. 91, 142; Can. Ent., X, 1878, p. 52.—RILEY, Smith's List Lep. Bor. Am., 1891, No. 5337.

Paltodora cilialineella, BUSCK, Dyar's List Amer. Lep., 1903, No. 5543.

Chambers pointed out the great similarity of this species to his species of *Cleodora*, and added:¹

I have not examined the neuration, but I am inclined to transfer the species to *Cleodora*.

I have compared the type No. 445, U.S.N.M., bearing Chambers's own label, with his type in the Museum of Comparative Zoology in Cambridge. They are identical and agree well with his description, evidently truly representing the species.

They are *Paltodora*, with the brush on second joint of labial palpi somewhat rubbed off.

The species is very near *pallidistrigella*, differing principally in the absence of the costal white edge and in the direction of the costal white line, which in this species is nearly parallel with the edge of costal cilia, while in *pallidistrigella* it is nearly perpendicular on it.

The differences pointed out by Chambers (Ref. 2) are not well borne out by his types.

Veins 6 and 7 of hindwing are connate.

PALTODORA DIETZIELLA, new species.

Paltodora dietziella BUSCK, Dyar's List Amer. Lep., 1903, No. 5544.

Palpi missing. Antennæ silvery white with dark brown annulations. Face white; head and thorax light fawn colored. Forewings fawn colored, at base concolorous with thorax, but becoming deeper toward the tip; on fold at middle of the wing a small black streak; at end of disk a small black dot. At the beginning of costal cilia obliquely outward across the tip of the wing a thin white line, and opposite it from the dorsal edge another thin white line curved upward and outward, nearly but not quite meeting the costal streak at the dorsal edge near the tip; both are continued out into and meet in the dorsal cilia, which is yellowish fuscous and contains two other white pencils below the continuation of the streaks.

In the cilia at apex is one heavy black transverse line, and outside

¹Bull. U. S. Geol. Surv., IV, p. 91.

this three thin black lines. Edging the costal white streak superiorly is a dark brown patch.

The ornamentation is very near that of *pallidistrigella*, with the same ground color and general pattern, but differs in the lack of the white costal edge and in the direction of the white costal streak, which in this species forms a narrow Greek ν with the dorsal streak, while in *pallidistrigella* it is shorter and much more nearly perpendicular.

Hindwings dark fuscous, cilia a shade lighter; veins 6 and 7 connate. Abdomen yellowish fuscous, with numerous scattered metallic blue and greenish scales. Legs light yellow.

Alar expanse.—16 to 16 mm.

Habitat.—Colorado. July.

Type.—No. 6346, U.S.N.M.

Cotypes in collection of Dr. Dietz, who has liberally submitted this species to me for description and in whose honor I name it.

PALTODORA CANICOSTELLA Walsingham.

Cleodora canicostella WALSINGHAM, Insect Life, I, 1888, p. 82.—RILEY, Smith's List Lep. Bor. Am., 1891, No. 5518.

Paltodora canicostella BUSCK, Dyar's List Amer. Lep., 1903, No. 5545.

Described from Mount Shasta, California; cotypes are in U. S. National Museum, where is also a specimen from Colorado. Veins 6 and 7 in hindwings are connate.

PALTODORA ANTELIELLA, new species.

Paltodora anteliella BUSCK, Dyar's List Amer. Lep., No. 5546, 1903.

Antennæ light fawn colored; labial palpi fawn colored, above whitish; face, head, and thorax light fawn colored. Anterior wings darker reddish brown; one short longitudinal streak on the fold and one similar in the middle of the wing black; second discal stigma circular black. From costal apical one-fourth very obliquely outward across the wing to termen a thin white line. Cilia fawn colored with a short, heavy black transverse line in apical part. Hindwings dark gray; cilia fawn colored; abdomen and legs light reddish brown; tarsal joints slightly tipped with white.

Alar expanse, 12 to 12.5 mm.

Habitat.—New Jersey.

Type.—No. 6347, U.S.N.M.

Cotypes in collections of Dietz and Kearfott. The small size and rich brown color make this species easily recognizable.

PALTODORA SABULELLA Walsingham.

Cleodora sabulella WALSINGHAM, Insect Life, I, p. 83, 1888.—RILEY, Smith's List Lep. Bor. Am., No. 5520, 1891.

Paltodora sabulella BUSCK, Dyar's List Amer. Lep., No. 5547, 1903.

Described from Colusa County, California. Cotypes are in U. S. National Museum. Hindwings with veins 6 and 7 connate.

PALTODORA SIMILIELLA Chambers.

Gelechia similiella CHAMBERS, Can. Ent., IV, 1872, p. 193.

Gelechia solaniella CHAMBERS, Can. Ent., VI, 1874, p. 242; Bull. U. S. Geol. Surv., III, 1877, p. 91; IV, 1878, pp. 91, 147.

Gelechia [*Doryphora*] *piscipellis* ZELLER, Verh. k. k., zool.-bot. Gesell. Wien, XXIII, 1873, p. 277.

Gelechia piscipellis RILEY, Smith's List Lep. Bor. Am., No. 5450, 1891.

Gelechia piscipalis CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.

Paltodora similiella BUSCK, Dyar's List Amer. Lep., No. 5548, 1903.

Not *Gelechia solaniella* CHAMBERS, Can. Ent., V, 1873, p. 176; Cinn. Quart. Journ. Sci., II, 1875, p. 239; Can. Ent., IX, 1878, p. 51.

This species has been quite troublesome to clear, owing to an erroneous determination by Chambers and the subsequent results of this mistake.

Only by the kind help of Miss Mary Murtfeldt's personal recollection, and with all obtainable evidence carefully examined, did I feel justified and confident in my conclusions in regard to the above synonymy.

Later I have had the satisfaction to have them substantiated in part through a letter from Lord Walsingham in the archives of the Division of Entomology, U. S. Department of Agriculture.

Chambers described¹ a species as *Gelechia similiella*. This was the same species that Zeller subsequently described as *piscipellis*, as comparison of the original types now in Cambridge, but presented by Chambers to the Peabody Academy of Science in Salem, shows, and it is a true *Paltodora*.

In 1873 Chambers received from Miss Murtfeldt a superficially similar species, which she had reared from *Solanum*, and believing it (wrongly) to be *similiella* Chambers, he changed that name to *solaniella* and gave *Solanum carolinensis* as its food plant,² and later he described it³ more fully and gave the life history in detail, still supposing it to be his original *similiella*.

Afterwards Miss Murtfeldt, unaware of this, described her species as *cinerella* Murtfeldt, afterwards changing it to *inconspicua*, the former name being preoccupied in Europe.

It was, however, already described by Zeller as *Gelechia* (*Bryotropha*) *glochinel* and belongs in Mr. Meyrick's recent genus *Phthorimaea*. (p. 821.)

To enable me to draw these conclusions I have had the good fortune to have the following authentic specimen for examination: 1. U. S. National Museum, type, No. 459, Chambers type with his label: *Gelechia solaniella* Chambers. This is identical with 2. the other original type sent to Peabody Academy, Salem, now in Museum of Comparative Zoology, bearing Lord Walsingham's blue label, No. 992 and Chambers' label No. 37, each referring to respective lists of the

¹Can. Ent., IV, p. 193. ²Idem., V, 1873, p. 176. ³Miss Murtfeldt's species.

two authors, which I have had the use of through the kindness of Professor Fernald, and Mr. Henshaw, respectively.

These two specimens, which evidently represent his original species, are *Paltodora* species and identical with 3. Zeller's type in Cambridge of *piscipellis*, and with 4. a specimen determined as *piscipellis* Zeller by Lord Walsingham, in U. S. National Museum.

Of the other species, bred from Solanum, I had 5. cotype and several other specimens, bred by Miss Murtfeldt, and it is identical with 6. a specimen in the U. S. National Museum determined and labeled by Lord Walsingham, *G. glochinella* Zeller, the description and figure of which also agree well with the specimens before me.

This species will be treated later under *Phthorimaea* Meyrick (p. 821), while the *similiella* Chambers=*piscipellis* Zeller should stand as *Paltodora*.

It is of value to note Chambers's suspicion¹ that he had two species mixed, as well as his note² that his *Gelechia ciliarilella*, which undoubtedly is a *Paltodora* species (p. 780), is only microscopically distinguishable from his "*Gelechia solaniella*," that is *similiella*.

It is a good species distinct from all at present described species nearest to *pallidella* Chambers, with which species it has the white-tipped scales in common.

Similiella was described from Kentucky, and Chambers's type in U. S. National Museum is from Texas, which is also the locality of Zeller's type of *piscipellis*.

Specimens in poor condition which I take to be this species were reared from flower heads of sunflower at the Insectary of U. S. Department of Agriculture, received from Mr. E. E. Bogue, Oklahoma.

This species has vein 6 and 7 of hindwing not only connate but in fact shortstaked.

PALTODORA TOPHELLA Walsingham.

Cleodora tophella WALSINGHAM, Insect Life, I, 1888, p. 83.—RILEY, Smith's List Lep. Bor. Am., No. 5519, 1891.

Paltodora tophella BUSCK, Dyar's List Amer. Lep., No. 5549, 1903.

U. S. National Museum possesses cotype, received from Lord Walsingham; also specimen collected at Beulah, New Mexico, 8,000 feet elevation by Prof. T. D. A. Cockerell.

Habitat.—California, New Mexico.

Veins 6 and 7 in hindwings are connate.

PALTODORA PALLIDELLA Chambers.

Cleodora pallidella CHAMBERS, Can. Ent., VI, 1874, p. 245; Bull. U. S. Geol. Surv., IV, 1878, pp. 92, 135.—WALSINGHAM, Insect Life, I, 1888, pp. 81, 82.—RILEY, Smith's List Lep. Bor. Am., No. 5515, 1891.

Paltodora pallidella BUSCK, Dyar's List Amer. Lep., No. 5550, 1903.

¹ Bull. U. S. Geol. Sur., III, p. 143.

² Can. Ent., VI, p. 242.

As remarked by Lord Walsingham, it is evident that Chambers, when he amended and elaborated his first description had more than one species before him, and some of his statements are in direct contradiction to the original description.

I believe, from careful comparison with all the material at my disposal, that he had specimens of *maguella* Busck and *dietziella* Busck mixed up with his original species.

The only authentic type from Chambers in existence is the one mentioned by Lord Walsingham (but not known to him) in Miss Murtfeldt's collection. That is now in Professor Fernald's possession, and I have had the opportunity to examine it.

It is a plain looking, grayish yellow species with white-tipped scales, similar to those of *similiella* Chambers (*piscipellis* Zeller, p. 779) and *tophella* Walsingham., very near to the latter, but smaller, and of a lighter, more yellowish ground color.

I have recognized an identical specimen in the U. S. National Museum and in Dr. Dietz's collection from Colorado.

This type specimen bears Chambers' label and agrees well with his original rather meager description, but does not agree with his later detailed description of the supposed same insect. It is obviously, under the circumstances, proper to disregard these latter amendments which evidently applied to one or more distinct species, and to retain the name *pallidella* for the pale, nearly unmarked species represented by the unique type in Professor Fernald's collection.

Veins 6 and 7 of hindwing are closely approximated.

PALTODORA MODESTA Walsingham.

Cleodora modesta WALSINGHAM, Insect Life, I, 1888, p. 82.—RILEY, Smith's List Lep. Bor. Am., No. 5517, 1891.

Paltodora modesta BUSCK, Dyar's List Amer. Lep., No. 5551, 1903.

Cotypes and other specimens of this small inconspicuous species from Los Angeles, California, are in the U. S. National Museum.

Hindwings with veins 6 and 7 connate.

SITOTROGA Heinemann.

Plate XXVIII, fig. 3.

Sitotroga HEINEMANN, Schmett. Deutschland und Schweiz, 1870, p. 287.

Basal joint of antennæ with long pecten. Labial palpi with second joints rough beneath; terminal joint longer than second, slender, pointed. Forewings very long, narrow, pointed, with 12 veins, 7 and 8 out of 6. Hindwings narrower than forewing, elongate trapezoidal, apex much produced, termen emarginate; 8 veins, 6 and 7 stalked; 2, 3, 4, and 5 remote parallel. Only the one cosmopolitan species is known.

SITOTROGA CEREALELA Olivier.

Sitotroga cerealella STAUDINGER and REBEL, Cat. Lep. Eur., II, No. 2902, 1901.—DIETZ, Smith's List Ins. N. Jersey, 1900, p. 475.—BUSCK, Dyar's List Amer. Lep., No. 5552, 1903.

Anacampsis cerealella GLOVER, U. S. Dept. Agr. Report, 1854, p. 67, pl. IV.

Gelechia cerealella CLEMENS, Proc. Phil. Acad., 1860, p. 168; Stainton ed. No. Am. Tin, 1872, pp. 112, 224.—PACKARD, Guide Study Ins., 1869, p. 350.—CHAMBERS, Bull. U. S. Geol. Surv., 1878, IV, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5335, 1891.

This common species, the Angoumois moth, is often of economic importance on account of the injuries of the larva to stored grain.

I have not attempted to give the very numerous references to the economic literature of the species.

AUTONEDA, new name.

Plate XXVIII, fig. 4.

Neda CHAMBERS, Can. Ent. VI, 1874, p. 243.

The name *Neda* being preoccupied in the Coleoptera, I propose the above modification to signify the genus which Chambers described¹ with *plutella* as type.

It has the following characters: Labial palpi, like those in *Ypsolophus*; second joint with large, dense, projecting tuft on under side; terminal joint erect, pointed, as long as second joint; forewings narrow, nearly lanceolate; 12 veins; veins 7 and 8 stalked to costa; 6 separate, but very approximate to 7; hindwings under I; apex produced termen emarginate; 8 veins, all separate; 6 and 7 somewhat approximate; 5 nearer 6 than 4.

At present only the one species is known.

AUTONEDA PLUTELLA Chambers.

Neda plutella CHAMBERS, Can. Ent., 1874, p. 244; Can. Ent., VII., 1875, p. 105; Bull. U. S. Geol. Surv., 1878, IV., p. 157.—RILEY, Smith's List Lep. Bor. Am., No. 5521, 1891.

Autoneda plutella BUSCK, Dyar's List Amer. Lep., No. 5553, 1902.

Type.—No. 468, U.S.N.M., with Chambers' label on the pin, agrees with his unusually accurate and complete generic and specific descriptions, and is identical with other types, also labeled by Chambers himself, in the Museum of Comparative Zoology at Cambridge. One of these bears Lord Walsingham's blue label, No. 979, corresponding with his identification in his notebook,² *Neda plutella*.

These types all undoubtedly represent this interesting species. They are all from Kentucky.

¹Can. Ent., VI, 1874, p. 243.

²Mentioned on p. 768.

GLAUCE Chambers.

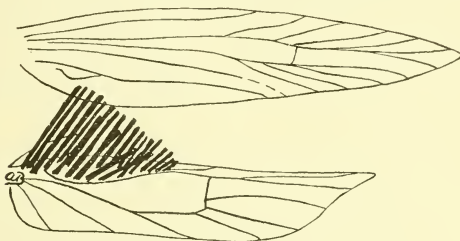
Glauce CHAMBERS, Can. Ent., VII, 1875, p. 11.

Labial palpi long, recurved, overarching the vertex; second joint slightly thickened with scales; terminal joint nearly as long as second, pointed.

Forewings elongate ovate, pointed; 12 veins, 7 and 8 out of 6; hindwings nearly as broad as forewings, trapezoidal; apex produced, pointed; termen sinuate; 8 veins, 6 and 7 stalked, 3 and 4 separate, 5 nearest 4; the costal margin from base to the middle is armed with a row of large, stiff, sharp, two-edged bristles.

Only the following species is known:

GLAUCE PECTENALÆELLA Chambers.



VENETIAN OF GLAUCE PECTENALÆELLA—CHAMBERS.

Glauce pectenallæella CHAMBERS, Can. Ent., VII, 1875, p. 12; Bull. U. S. Geol. Surv., IV, 1878, p. 148; Journ. Cinn. Soc. Nat. Hist., II, 1880, p. 203, fig. 22.—RILEY, Smith's List Lep. Bor. Am., No. 5291, 1891.—BUSCK, Dyar's List Amer. Lep., No., 5642, 1903.

This characteristic species, all authentic material of which is lost, I have recently recognized beyond doubt among *Tineina* collected by the writer at light in the District of Columbia and in the neighborhood of Covington, Kentucky.

Chambers's description and figure of the wing is essentially correct, except that he has made vein 6 in forewing out of vein 7, instead of 7 and 8 out of 6, an easily explained error.

Chambers's type came from Texas.

TELPHUSA Chambers.

Plate XXVIII, fig. 5.

Telphusa CHAMBERS, Can. Ent., IV, 1872, p. 182;

Xenotechia MEYRICK, Handbook Brit. Lep., 1895, p. 583.

Chambers erected this genus for his species *curvistrigella*, the unique type of which is still in the Museum of Comparative Zoology in Cambridge, with Chambers' label on the pin, and recognizable, though in poor condition.

Chambers shortly afterwards gave up this genus and included his species in *Gelechia* as a synonym of Clemens's *Gelechia longifusciella*, but a name is needed to signify the genus, which Chambers can hardly be said to have defined, but which has the following characters in common with *curristrigella*. Chambers' name must stand in preference to Meyrick's later name *Xenolechia*.

I strongly suspect that Chambers' genus, *Adrasteia*, is synonymous with the present genus, in which case that name would supplant *Telphusa*, but for the time being it must be left as "unrecognized." The types of the two species, *Adrasteia alexandrixella* and *A. fusciella*,¹ on which Chambers erected the genus, are lost, and though I feel rather certain that I have recognized both species as belonging to *Telphusa*, still altogether insufficient collecting has been done in Kentucky, from where these species are described, to warrant final conclusions from the limited material on hand, and at present I must leave both genus and species as unrecognized. There is no way to include the genus in any table, as Chambers did little more than attach the name to those two species without further specification; the only tangible generic character given is the tufted forewings.

Telphusa has the following characters: Second joint of labial palpi thickened with rough scales beneath, terminal joint slender pointed.

Forewings elongate pointed, 12 veins, 7 and 8 stalked, 6 separate or out of 7 near base; hindwings trapezoidal, apex pointed termen sinuate, as broad or broader than the forewings; 8 veins, 6 and 7 stalked, 3 and 4 separate, 5 nearest 4. Forewings often with tufts of raised scales.

The American species at present recognized as belonging to this genus may be separated by the following table:

With oblique light fascia at basal fourth of forewings	1
Without such light fascia	2
1. Forewings with apical half of dorsal edge white.....	<i>longifusciella</i> , p. 785
Dorsal edge not white	<i>lutifusciella</i> , p. 783
2. Ground color of forewings white	3
Ground color not white.....	4
3. Markings on forewings black.....	5
Markings fawn colored	<i>betulella</i> , p. 787
4. With complete black fascia crossing forewings	<i>basistrigella</i> , p. 787
Black fascia not reaching dorsal edge	<i>basifusciella</i> , p. 787
5. Wings very dark fuscous, nearly black	<i>quinquecirstatella</i> , p. 785
Wings lighter, gray	6
6. With oblique black streak from costa near base	7
Without such streak	8
7. Head and thorax dark fuscous.....	<i>quercinigracella</i> , p. 786
Head and thorax light brownish.....	<i>palliderosasella</i> , p. 786
8. Forewings with raised scales	<i>querciella</i> , p. 787
Forewings without raised scales.....	9
9. With sharply defined dark spot on disc.....	<i>glandiferella</i> , p. 788
Without such spot	<i>belangerella</i> , p. 788

¹ Can. Ent., IV, 1872, p. 149.

TELPHUSA LONGIFASCIELLA Clemens.

Gelechia longifasciella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, pp. 12, 121; Stainton, Tin. N. A., 1872, pp. 219, 223.—CHAMBERS, Can. Ent., IV, 1872, p. 174; Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5402, 1891.

Telphusa curvistrigella CHAMBERS, Can. Ent., IV, 1872, p. 133.

Gelechia obliquifasciella CHAMBERS, Journ. Cinn. Soc. Nat. Hist., II, 1879, p. 182.—RILEY, Smith's List Lep. Bor. Am., No. 5421, 1891.

Telphusa longifasciella BUSCK, Dyar's List Amer. Lep., No. 5554, 1902.

Chambers dropped *curvistrigella* as a synonym of Clemens's *longifasciella*.

In the Museum of Comparative Zoology in Cambridge are types of *curvistrigella* and *obliquifasciella* with Chambers's handwriting. They are identical, as the description would indicate, and Chambers has here again evidently been a victim of his own carelessness with his types.

I have met with no other specimens.

Habitat.—Texas, Kentucky.

TELPHUSA QUINQUECRISTATELLA Chambers.

Gelechia quinquecristatella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 88, 146.—RILEY, Smith's List Lep. Bor. Am., No. 5465, 1891.

Telphusa quinquecristatella BUSCK, Dyar's List Amer. Lep., No. 5555, 1903.

The specimens in the U. S. National Museum, determined by Lord Walsingham as *Gelechia quinquecristatella* Chambers, agree with Chambers's description and undoubtedly represent this species.

I am unable to distinguish it from authentic specimens (unfortunately poor) of the European (*Yenolechia*) *æthiops* Westwood, and I sent specimens to Dr. E. Meyrick, who also identified it as this species.

However, the European food-plant of *æthiops*, *Erica cinerea*, does not grow wild in this country, and until the species has been bred here there is a possibility that it is another, closely related species, and it will be safer to retain it as such until then; but the imagos are surely very similar.

Habitat.—Eastern United States.

TELPHUSA LATIFASCIELLA Chambers.

Gelechia latifasciella CHAMBERS, Cinn. Quart. Jour., II, 1875, p. 251; Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5399, 1891.

Telphusa latifasciella BUSCK, Dyar's List Amer. Lep., No. 5556, 1903.

I have examined types in Professor Fernald's collection and in the Museum of Comparative Zoology in Cambridge. In the National Museum are specimens received from Miss Murtfeldt, who writes that she has bred both the light and the dark forms from similar larvæ

in rolled leaves of oak. I have taken a few specimens from around Washington, District of Columbia.

Habitat.—Kentucky, Missouri.

TELPHUSA QUERCINIGRACELLA Chambers.

Gelechia quercinigracella CHAMBERS, Can. Ent., IV, 1872, p. 170.

Gelechia (*Pocilia*?) *fragmentella* ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 71.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5365, 1891.

Gelechia quercinigracella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5460, 1891.

Telphusa quercinigracella BUSCK, Dyar's List Amer. Lep., No. 5557, 1903.

Placed by mistake among the types of *Gelechia* (*Recurvaria*) *quercivorella* Chambers in the Museum of Comparative Zoology in Cambridge, and therefore omitted in Hagen's list of types¹, I found a specimen differing from the others and labeled in Chambers's handwriting *G. quercinigracella*.

This specimen agrees perfectly with Chambers's description, and without doubt represents this species. It is, so far as I know, the only authentic specimen of this species from Chambers in existence.

It is, as the descriptions would indicate, identical with Zeller's type of *fragmentella*, also found in the Museum of Comparative Zoology. Both are females.

In the U. S. National Museum there is a good series of this species bred by the writer from larvæ on oak, agreeing well with Chambers's description of the larva.

Habitat.—Texas, Kentucky, District of Columbia, and New York.

TELPHUSA PALLIDEROSACELLA Chambers.

Gelechia (*Ergatis*) *palliderosacella* CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 90 and 145.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 180.—RILEY, Smith's List Lep. Bor. Am., No. 5440, 1891.

Telphusa palliderosacella BUSCK, Dyar's List Amer. Lep., No. 5558, 1903.

In the U. S. National Museum there are specimens determined by Lord Walsingham which I believe truly represent this species. I have received similar specimens from Miss Murtfeldt under that name, which agree with Chambers's description.

Food plant.—Oak.

Habitat.—Texas, Missouri, District of Columbia, Pennsylvania, and New York.

What has been supposed to be a type of *palliderosacella* with Chambers's label on the pin is found in the Museum of Comparative Zoology in Cambridge, but it does not agree with his description and some mistake has obviously been made; it is a much rubbed *Aristotelia* of the *rososuffusella* group.

¹Papilio, IV, 1884, p. 98.

TELPHUSA QUERCIELLA Chambers.

Depressaria querciella CHAMBERS, Can. Ent., IV, 1872, pp. 127, 147.

Adrasicia querciella CHAMBERS, Can. Ent., IV, 1872, p. 207.

Gelechia querciella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5463, 1891.—DIETZ, Smith N. J. Insects, 1900, p. 474.

Telphusa querciella BUSCK, Dyar's List Amer. Lep., No. 5559, 1903.

Type No. 460, U.S.N.M., of this species, agrees with other specimens from Chambers in Professor Fernald's collection and in the Museum of Comparative Zoology in Cambridge. I have met with no other specimen.

Food plant.—Oak (Chambers).

Habitat.—Kentucky, New Jersey.

TELPHUSA BASISTRIGELLA Zeller.

Gelechia (Pacilia?) basistrigella ZELLER, Verh. k. k. zool.-bot. Gesellsch. Wien, 1873, p. 270, pl. LV, fig. 23.

Gelechia basistrigella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1870, p. 141.—RILEY, Smith's List Lep. Bor. Am., 5318, No. 1891.

Telphusa basistrigella BUSCK, Dyar's List Amer. Lep., No. 5560, 1903.

The unique type of this species is in the Museum of Comparative Zoology in Cambridge in good condition. I have not seen other specimens which I can refer with certainty to this species.

Habitat.—Texas.

TELPHUSA BASIFASCIELLA Zeller.

Gelechia (Pacilia) basifasciella ZELLER, Verh. k. k. zool.-bot. Gesellsch. Wien, 1873, p. 269, pl. III, fig. 22.

Gelechia basifasciella CHAMBERS, Bull. U. S. Geol. Surv., IV., 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5319, 1891.—DIETZ, Smith's List Insects N. J., 1900, p. 474.

Telphusa basifasciella BUSCK, Dyar's List Amer. Lep., No. 5561, 1903.

I have examined the types of this easily recognized species in the Museum of Comparative Zoology in Cambridge. In the U. S. National Museum there is a specimen identical with these determined by Lord Walsingham.

Habitat.—Texas, New Jersey (Dietz).

TELPHUSA BETULELLA, new species.

Telphusa betulella BUSCK, Dyar's List Amer. Lep., No. 5562, 1903.

Antennae $\frac{3}{5}$, simple, slightly serrate toward tip, light reddish, with base of each joint silvery white and tip of each joint dark brown.

Labial palpi, second joint thickened, with rough scales beneath, silvery white slightly sprinkled with drap scales and with base drap; terminal joint suffused with drap and black scales, a small spot on the inner side near the middle and the extreme tip whitish. Face and

head light silvery drap, thorax a shade darker. Forewings silvery white suffused irregularly with drap scales, especially below fold and in the apical part; extreme base of costa black; at middle of wing a small dark drap costal spot; near base of wing, just below costa, a large tuft of raised scales; on middle of fold, at end of disk and beyond disk, are similar smaller tufts of raised scales, not very conspicuous and of the general color of the wing, white and drap mixed.

In apical part and at base of the cilia a few scattered black scales; cilia whitish.

Hindwing light silvery gray, cilia golden white. Abdomen and legs golden white, slightly sprinkled with drap. Venation typical; veins 6 and 7 in hindwing very shortly stalked.

Alar expanse.—12 to 13 mm.

Habitat.—District of Columbia, Virginia.

Food plant.—*Betula nigra*.

Type.—No. 6348, U.S.N.M.

Described from several specimens bred in March, 1884, by Mr. Th. Pergande, and in August, 1899, by the writer.

The larvæ are leaf rollers on black birch and pupate in the leaf. Imago appear during August and another brood overwinters as pupa, producing adults in early spring.

TELPHUSA BELANGERELLA Chambers.

Gelechia belangerella CHAMBERS, Can. Ent., VII, 1875, p. 210; Bull. U. S. Geol.

Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5320, 1891.

Gelechia (Teleia) oronella WALSHINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 179.

Gelechia oronella PACKARD, Fifth Rep. U. S. Ent. Comm., 1890, p. 630.—RILEY, Smith's List Lep. Bor. Am., No. 5436, 1891.

Gelechia orella DIETZ, Smith's List Ins. N. Jersey, 1900, p. 474.

Telphusa belangerella BUSCK, Dyar's List Amer. Lep., No. 5563, 1903.

The unique well-preserved type of *Gelechia belangerella* was obtained from Laval University, Quebec, and is now in the U. S. National Museum under type No. 5767. In that collection are also specimens compared by the writer with Walsingham's type of *Gelechia oronella* in Professor Fernald's collection.

As the description would indicate the two species are identical. Chambers name must stand. Larva is leaf roller on alder (Packard).

Habitat.—Eastern United States, Canada.

TELPHUSA GLANDIFERELLA Zeller.

Gelechia (Anacampsis) glandiferella ZELLER, Verh. k. k. zool.-bot. Gesellsch. Wien, XXIII, 1873, p. 275, pl. IV, fig. 25.

Gelechia sella CHAMBERS, Can. Ent., VI, 1874, p. 238.

Gelechia glandifuella CHAMBERS, Can. Ent., IX, 1877, p. 14.

Gelechia glandifera CHAMBERS, Can. Ent., IX, 1877, p. 24.

Gelechia glandiferella CHAMBERS, U. S. Geol. Surv. Bull., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5382, 1891.

Xenolechia glandiferella WALSINGHAM, Proc. Zool. Soc. London, 1897, p. 72.

Telphusa glandiferella BUSCK, Dyar's List Amer. Lep., No. 5564, 1903.

In the U. S. National Museum are types of both Zeller's and Chambers's species. I have also examined the types of both in the Museum of Comparative Zoology. They all represent the form figured by Zeller, with the large wing spot reaching down to the dorsal edge.

Chambers mentioned a variety in which this spot is represented by a triangular spot on the fold, not reaching the margin. This supposed variety is also represented in the National Museum, labeled by Lord Walsingham *Gelechia glandiferella*. I am inclined to believe it a quite distinct species, but until its life history is known it may remain under the present species.

Riley made *pallidocherella* Chambers a synonym of this species, but, as I have shown,¹ this is a mistake. Chambers described only two species as *pallidochrella*, the one is type of *Helice* [p. 804], and probably is the one confounded with the above; the other is a *Gnorimoschema* [p. 828].

AGNIPPE Chambers.

Plate XXVIII, figs. 6-7.

Agnippe CHAMBERS, Can. Ent., IV, p. 194.

Labial palpi long curved; second joint slightly thickened, with rough scales beneath toward apex, terminal joints smooth pointed, nearly as long as second.

Forewings elongate ovate, pointed: 10 or 11 veins; vein 11 absent; vein 5 absent or out of 4, 7 and 8 out of 6. Hindwings slightly broader than forewings; trapezoidal apex pointed; termen sinuate; 7 veins, 6 absent; 2, 3, 4, and 4 separate, equidistant; cell open between 5 and 7.

Only two species are at present recognized, which may be separated thus:

Vein 5 in forewing, present; head brownish, *biscolorella*, p. 789.

Vein 5 in forewing, absent; head white, *fuscopulvella*, p. 790.

AGNIPPE BISCOLORELLA Chambers.

Agnippe biscolorella CHAMBERS, Can. Ent., IV, 1872, p. 195; V, 1873, p. 230; VII, 1875, p. 106; IX, 1877, p. 231; Bull. U. S. Geol. Surv., IV, 1878, p. 128.—RILEY, Smith's List Lep. Bor. Am., No. 5296 [part], 1891.—BUSCK, Dyar's List Amer. Lep., No. 5567, 1903.

Type No. 442, in the U. S. National Museum, of the species, is identical with type in Professor Fernald's collection and types in the Museum of Comparative Zoology, and agrees perfectly with Chambers's generic and specific description.

¹ Journ. New York Ent. Soc., X, 1902, p. 93.

The synonymy with the following species, which Chambers himself suggested, will not stand as explained under that species.

Food plant.—Chambers surmised¹ that this species fed in some way on *Gleditschia triacanthos* (honey locust), but nothing definitely is known of the early stages.

Habitat.—Kentucky.

AGNIPPE FUSCOPULVELLA Chambers.

Agnippe fuscopulvella CHAMBERS, Can Ent., IV, 1872, p. 195.—BUSCK, Dyar's List Amer. Lep., No. 5568, 1903.

Agnippe bicolorella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 128.

Agnippe bicolorella var. *fuscopulvella* RILEY, Smith's List Lep. Bor. Am., No. 5296a, 1891.

Though at first recognizing this as a distinct species, Chambers was led later by the superficial similarity to make it a synonym of the foregoing species.

In the U. S. National Museum, however, is, besides the type of *bicolorella*, another specimen received from Chambers at the same time as this. It is in Chambers's mounting and furnished with an identical small label and the number 7, as is found on the pin of *bicolorella*. But it is a different, though very similar insect, which agrees well with Chambers's description of *fuscopulvella*, and which I feel confident is the original type of that species. This view was substantiated during a study of Chambers's types in the Museum of Comparative Zoology in Cambridge, where types of both species, correctly named by Chambers himself, were found.

A superficial examination might bring the conclusion, as it did to Chambers, that *fuscopulvella* is a worn specimen, or a variety of *bicolorella*, but when closely examined it is easily seen that the dirty whitish ground color in *fuscopulvella*, which gives the appearance of a worn wing, really is intact and suits Chambers's description of *fuscopulvella* well.

And a study of the venation will show that though very similar to that of *bicolorella* it differs in lacking vein 5 on the forewings.

All other points in venation, form of wing, and palpi are identical with those of the type of the genus, the definition of which I have therefore only widened in that one respect.

Habitat.—Kentucky.

NEALYDA Dietz.

Plate XXVIII, fig. 8.

Nealyda DIETZ, Ent. News, XI, 1900, p. 350; Proc. U. S. Nat. Mus., XXIII, 1900, p. 228.

Labial palpi moderate, curved, ascending, smooth, second joint

¹ Can Ent., IX, p. 231.

slightly thickened with appressed scales; terminal joint shorter than second, also somewhat thickened with scales, pointed. Forewings ovate, pointed, with very heavy scaling, making them appear proportionately broader; 12 veins, 7 and 8 stalked. Hindwings under I, trapezoidal; apex produced; termen so deeply emarginate as to make wing bilobed; 6 veins, 5 and 6 absent, 7 to apex cell open between 4 and 7.

The larvæ are leaf miners; they are flattened, suggesting *Lithocolletis* larvæ of the flat type; abdominal legs on segments 7-10 long, thin, with globular swelling at the end; no anal feet; they pupate in flat cocoons outside the mine.

Only three species are at present known, but that more remain to be discovered is proven by the supposed type of *Gelechia grisse fasciella* Chambers, in the Museum of Comparative Zoology in Cambridge, which is an undescribed species of *Nealyda*.

The described species may be separated as follows:

1. Dark fascia sharply defined on both sides.....*pisoniæ*, p. 791
2. Dark fascia not sharply defined toward the base of wing..... 3
3. Labial palpi dark; both joints tipped with white.....*bifidella*, p. 791
- Labial palpi light, not tipped with white.....*kinzelella*, p. 792

NEALYDA PISONIÆ Busck.

Nealyda pisoniæ BUSCK, Proc. U. S. Nat. Mus., XXIII, 1900, p. 229, pl. 1, fig. 5.—DYAR, Proc. Wash. Ent. Soc., IV, 1901, p. 470.—BUSCK, Dyar's List Amer. Lep., No. 5569, 1902.

Types of male and female are found in the U. S. National Museum (No. 4935).

Larva makes large trumpet-formed upper mine in leaves of *Pisonia aculeata*.

Habitat.—Palm Beach, Florida.

NEALYDA BIFIDELLA Dietz.

Nealyda bifidella DIETZ, Ent. News, XI, 1900, p. 351, pl. 1, fig. 2.—BUSCK, Proc. U. S. Nat. Mus., XXIII, 1900, p. 228.—DYAR, Proc. U. S. Nat. Mus., XXV, 406, 1902.—BUSCK, Dyar's List Amer. Lep., No. 5570, 1903.

In the U. S. National Museum is a cotype received from Dr. Dietz; also a large series of perfect specimens bred by Dr. Dyar and the writer from material collected by Dr. Dyar at Salida, Colorado, in July, 1901.

The larva works as leaf miner in the identical manner as the two other species, and has the same strange form and development of the abdominal legs; anal legs absent.

Food plant.—*Allionia nycetaginea*.

Habitat.—Colorado.

NEALYDA KINZELELLA Busck.

Nealyda kinzelella Busck, Proc. U. S. Nat. Mus., XXIII, 1900, p. 230; Dyar's List Amer. Lep., No. 5571, 1903; DYAR, Proc. Ent. Soc. Washington, IV, p. 471, 1901.

Types are in U. S. National Museum (No. 4936).

Larva is leaf miner on *Pisonia obtusata*.

Habitat.—Palm Beach, Florida.

CHRYSOPORA Clemens

Plate XXIX, fig. 9.

Chrysopora CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 362.

Nomia CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 167.

Namodia HEINEMANN, Schmetterlinge Deutschland und der Schweiz, 1870, p. 284.

Labial palpi moderate, curved smooth, thin pointed, terminal joint shorter than second joint. Forewings narrow, ovate, pointed; 12 veins, 7 and 8 stalked, 6 separate. Hindwing under I; apex greatly produced; hind margin deeply and circularly excavated beneath it and anal angle rounded; 7 veins, 6 absent, cell not closed, 5 nearly obsolete approximate to 4, 3 and 4 separate.

This genus, of which *lingulacella* Clemens is the type, seems a development from *Aristotelia*, and forms an interesting step toward the extreme form of hindwings as found in the foregoing genus *Nealyda* Dietz.

The larvæ, as far as known, are leaf miners on *Atriplex* and *Chenopodium*.

Only the following two species are at present recognized from America:

With uninterrupted silvery fascia before middle of forewing *hermanella*, p. 793

Silvery fascia interrupted at the fold *lingulacella*, p. 792

CHRYSOPORA LINGULACELLA Clemens.

Nomia lingulacella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 167; Stainton Ed. Nor. Am. Tin., 1872, p. 124.

Chrysopora lingulacella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 362; Stainton Ed. Nor. Am. Tin., 1872, p. 158.—Busck, Dyar's List Amer. Lep., No. 5572, 1903.

Gelechia hermanella CHAMBERS, Can. Ent., IV, 1872, pp. 67 and 169; Ent. Mo. Mag., XI, 1875, p. 279; Bull. U. S. Geol. Surv., IV, 1878, pp. 117 and 144; Can. Ent., X, 1878, p. 52.—RILEY, Smith's List Lep. Bor. Am., No. 5393, 1891.

Chrysopora lingulacella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 134.

Gelechia hermonella CHAMBERS, Can. Ent., IV, 1878, p. 173.

Gelechia armeniella FREY and BOLL, Stett. Ent. Zeit., XXXIX, 1878, p. 249.—RILEY, Smith's List Lep. Bor. Am., No. 5314, 1891.

Clemens's type of this species is lost, but there is no difficulty in identifying this striking insect from his careful description.

It is the same species which Chambers, judging from Stainton's figure of that species, persistently but wrongfully identified as *hermanella* Fabricius, although he himself noticed several differences from this European species, both in the larva and in the imago.

The similar life mode and the common food plant of these two species, together with the great resemblance in coloration, made this mistake very natural.

Frey, who was acquainted with the European *hermanella* in nature, distinguished between the two and described the American species as *Gelechia armeniella*, not recognizing that it had already been described by Clemens, a fact which Chambers afterwards realized and brought out in his index, still, however, clinging to his belief that it was nothing but a variety of *hermanella*.

Chambers, writing on this species, said that he first found the true *hermanella* at Lake Michigan, and afterwards what he called the variety in Kentucky. This may be possible, but all evidence indicates that he was mistaken in his first determination, and that it was *Chrysopora lingulacella* bred from *Chenopodium album*. His notes on differences in larva and imago from Stainton's figure of *hermanella* indicate this.

In all events, I have examined all existing specimens, determined by Chambers in the United States National Museum, in the Museum of Comparative Zoology in Cambridge, and in Professor Fernald's collection. They are all alike and represent Clemens's species.

Food plant.—*Chenopodium* and *Atriplex*.

Habitat.—Michigan, Kansas, Kentucky, Missouri, Pennsylvania, District of Columbia.

CHRYSOPORA HERMANELLA Fabricius.

Linea hermanella FABRICIUS, Species Insectorum, II, 1781, p. 509.

Chrysopora hermanella STAUDINGER and REBEL, Cat. Lep. Eur., II, No. 2896, 1901.—

BUSCK, Dyar's List Amer. Lep., No. 5573, 1903.

I have seen only a single specimen of this species from America; the one sent me for determination from Laval University, Quebec, Canada. The U. S. National Museum contains a fine series of European specimens.

LEUCE Chambers.

Plate XXIX, fig. 10.

Nera CHAMBERS, Can. Ent., VII, 1875, p. 9.

Leuce CHAMBERS, Can. Ent., VII, 1875, p. 51.

Labial palpi rather short, second joint thickened with large tuft beneath; terminal joint shorter than second, thickened with appressed scales, blunt. Forewings elongate, ovate, pointed; 12 veins, 7 and 8 stalked, 3 and 4 connate from corner of cell, 2 distant, long; with tufts of raised scales. Hindwing less than I trapezoidal, apex produced,

termen sinuate, anal angle rounded; 8 veins, 6 and 7 parallel, 3 and 4 closely approximate, 5 nearest 4.

The genus was placed by Riley in the Lavernidæ in Smith's List Lep. Bor. Am., probably on account of Chambers's mistake in re-describing the type as *Laverna fuscoeristatella*. This, however, Chambers himself corrected, and his description as well as his types prove that it belongs to the *Gelechiidæ*. Only the one species is at present recognized.

LEUCE FUSCOCRISTATELLA Chambers.

Nera fuscoeristatella CHAMBERS, Can. Ent., VII, 1875, p. 9; Bull. U. S. Geol. Surv., IV, 1873, p. 157.

Laverna fuscoeristatella CHAMBERS, Can. Ent., VII, 1875, p. 34.

Leuce fuscoeristatella CHAMBERS, Can. Ent., VII, 1875, p. 51.—RILEY, Smith's List Lep. Bor. Am., No. 5740, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5574, 1903.

Anarsia (?) belfragesella CHAMBERS, Journ. Cinn. Soc. Nat. Hist., II, 1879, p. 183.—RILEY, Smith's List Lep. Bor. Am., No. 5542, 1891.

Type No. 495 in the U. S. National Museum of *Nera fuscoeristatella* is identical with the type of this species in Professor Fernald's collection and types in the Museum of Comparative Zoology.

They agree well with the description, and are all authenticated by Chambers's handwriting on the labels.

Anarsia ? belfragesella is another name for this species, as Chambers's descriptions and his authentic type in the museum in Cambridge prove.

All of these types are from Texas. I have met with no other specimen.

ARISTOTELIA Hübner.

Plate XXIX, fig. 11.

Aristotelia HÜBNER Verz. bek. Schm., 1818, p. 424.

Eucatoptus WALSHINGHAM, Proc. Zool. Soc. Lond., 1897, p. 69.

Labial palpi long, slender, curved; second joint thickened with appressed scales, somewhat roughened beneath; terminal joint long, smooth, pointed.

Forewings narrow, elongate, pointed; 12 veins, 7 and 8 stalked. Hindwings as broad or nearly as broad as forewings, elongate trapezoidal, apex produced, pointed, termen emarginate; 8 veins, all separate, 3, 4, and 5 remote from each other, 6 and 7 parallel.

Lord Walsingham has separated,¹ under the generic name *Eucatoptus*, such species of this genus in which the males have a costal hair pencil from base of hindwing. I can not, however, believe that this is a good generic character and that *Eucatoptus* should be retained as

¹Proc. Zool. Soc. Lond., 1897, p. 69.

a good natural genus. That character¹ is found in several genera, and very closely allied species are found differing in the presence or absence of this hair pencil, while others, evidently farther apart, would go together on account of the possession of it.

Miss Murtfeldt's species *Eucatoptus striatella*,² however, can not be included in that genus, and consequently not in the present, as it has veins 3 and 4 in hindwings connate and also differs in palpal characters. It belongs to Meyrick's recent genus *Phthorinæa*, under which it will be treated.

Of the species included in *Aristotelia* by Dr. Dietz,³ *pinifoliella* Chambers will be found treated under *Paralechia* Buseck, *attributella* under *Epitheetis* Meyrick, and *dorsivittella* under *Recurvaria* Haworth.

The species at present recognized belonging to this genus may be separated thus:

Forewings, unicolorous, or nearly so	1
Forewings, not unicolorous	7
1. Ground color light, white, or yellowish	2
Ground color dark, black, or fuscous	5
2. Forewings with five black discal dots	<i>quinquepunctella</i> , p. 804
Forewings without such five dots	31
3. With light yellow costal streak at beginning of cilia	4
Without such streak	<i>discomotella</i> , p. 802
4. Tip of terminal joint of labial palpi black	<i>kearfottella</i> , p. 803
Tip of labial palpi not black	<i>gilvotiniella</i> , p. 803
5. Antennæ with fifth and tenth apical joint white above	<i>absconditella</i> , p. 801
Antennæ without white joints	6
6. Face creamy yellow	<i>physaliella</i> , p. 802
Face dark	<i>minimella</i> , p. 802
7. With metallic markings	8
Without metallic markings	10
8. Basal two-thirds of forewing light yellow	<i>cockerella</i> , p. 800
Basal two-thirds of forewing not yellow	9
9. With row of black discal dots	<i>elegantella</i> , p. 799
Without such row of dots	<i>argentifera</i> , p. 800
10. Forewings with dark fascia at apical third	11
Without such fascia	12
11. Head and thorax light yellow	<i>bifasciella</i> , p. 799
Head and thorax dark	<i>molestella</i> , p. 797
12. Forewings more or less roseate	13
Forewings not roseate	<i>iva</i> , p. 799
13. With pure white costal markings	<i>rosceusuffusella</i> , p. 796
Without pure white costal markings	14
14. Males with costal hair pencil at base of hindwing	<i>rubidella</i> , p. 798
Males without such hair pencil	5
15. Extreme apex of third joint of labial palpi black	<i>putibundella</i> , p. 796
Apex not black	<i>fungivorella</i> , p. 798

¹This hair pencil is of an entirely other and less important nature than the one found in the genus *Phthorinæa* Meyrick (p. 821), where the wing itself is modified for its reception.

²Can. Ent., XXXII, 1900, p. 163.

³Smith's List of New Jersey Insects, 1900.

ARISTOTELIA ROSEOSUFFUSELLA Clemens.

- Gelechia roseosuffusella* CLEMENS, Proc. Acad. Nat. Sci. Phila., XII, 1860, pp. 162, 434; Proc. Ent. Soc. Phila., II, 1863, p. 121; Proc. Ent. Soc. Phila., III, 1864, p. 508; Stainton Ed. Tin. N. Am., 1872, pp. 40, 113, 225, 262.—CHAMBERS, Can. Ent., IV, 1872, pp. 69, 148, 169, 193; Bull. U. S. Geol. Surv., III, 1877, pp. 125, 141; Can. Ent., IX, 1877, p. 14; Bull. U. S. Geol. Surv., IV, 1878, pp. 110, 146; Journ. Cinn. Soc. Nat. Hist., II, 1880, p. 183.—MURTFELDT, Can. Ent., VI, 1874, p. 222; Bull. U. S. Dept. Agr. Div. Ent., 1891, pp. 23, 53.—RILEY, Smith's List Lep. Bor. Am., No. 5470, 1891.
- Gelechia rosasuffusella* CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 290.
- Gelechia (Ergatis) roseosuffusella* ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1872, p. 272, pl. IV, fig. 24.—WALSINGHAM, Trans. Am. Ent. Soc., X, 1882, p. 180.
- Gelechia bellela* WALKER, Cat. Lep. Ins. Brit. Mus., XXIX, 1864, p. 595.
- Aristotelia roseosuffusella* WALSINGHAM, Proc. Zool. Soc. Lond., 1897, p. 66.—DIETZ, Smith's List N. Jers. Insects, 1900, p. 474.—BUSCK, Proc. U. S. Nat. Mus., XXIII, 1900, p. 226; Dyar's List Amer. Lep., No. 5575, 1903.

There is great need of careful observations on and breeding of this and the several closely allied species. To Miss Mary Murtfeldt is due what has been done already in this direction in this group, and without her records we should be still more at sea than now is the case.

What I provisionally, in common with Miss Murtfeldt and Lord Walsingham, take to be this species is the same as Zeller held to be *roseosuffusella*, as is shown by Zeller's authentic specimens in Cambridge and in the U. S. National Museum. It is also what Chambers and Riley thought to be the species, as is shown by the specimens determined by them. This species breeds in *Trifolium pratense* and is common all over the continent and is also found in the West Indies.

But Clemens says expressly that *roseosuffusella* feeds in the fruit panicles of sumach.¹

It is unlikely that the species has both food plants. I have endeavored during the last years to breed all Micro-lepidoptera found on sumach with this particular question in view, but have not met with any which belong in this group.

Clemens made his statement about the food plant four and a half years after his description of the insect, and has possibly made a mistake somehow; but if ever a *Gelechiid* answering his description is bred from sumach, it must of course retain Clemens's name and a new name must be provided for the *Trifolium* feeder.

In the U. S. National Museum are two specimen named by Zeller, one labeled by Chambers, and three by Lord Walsingham, besides numerous specimen from many different localities.

ARISTOTELIA PUDIBUNDELLA Zeller.

- Gelechia (Ergatis) pudibundella* ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 273.—WALSINGHAM, Trans. Am. Ent. Soc., X, 1882, p. 181.

¹Proc. Ent. Soc. Phila., III, p. 508.

- Gelechia pudibundella* CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5454, 1891.
- Gelechia intermediella* CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 89, 144.—WALSINGHAM, Trans. Am. Ent. Soc., X., 1882, p. 180.—MURTFELDT, Bull. U. S. Dept. Agri. Div. Ent., 23, 1871, p. 53.—RILEY, Smith's List Lep. Bor. Am., No. 5392, 1891.
- Aristotelia pudibundella* WALSINGHAM, Proc. Zool. Soc. Lond., 1897, p. 66.—BUSCK, Proc. U. S. Nat. Mus., XXIII, 1900, p. 226; Dyar's List Amer. Lep., No. 5576, 1903.
- Aristotelia intermediella* DIETZ, Smith's List Ins., N. Jersey, 1900, p. 475.

Of this species I have examined Zeller's types in Cambridge and in the U. S. National Museum, which are alike; also a large series of moths bred from apple by Miss Murtfeldt (as *intermediella*?) and at the U. S. Department of Agriculture.

Whether Miss Murtfeldt was right in her determination of her species bred from apple as *intermediella* Chambers, and consequently Lord Walsingham's conclusion that *intermediella* is synonymous with Zeller's species, is not apparent to me. A specimen in the National Museum determined by Lord Walsingham as *intermediella* does not strengthen the theory. I believe there are several more species than now recognized, all very similar, and that differences in the larvæ will show this, when sufficient breeding has been done. I have several closely similar specimens, bred and collected, which I feel confident are new species, but I shall not attempt further description until full life histories have been worked out, as it would only make this group still more intricate. At present at least it will be necessary and convenient to relegate Chambers's poorly defined species as a synonym, according to Lord Walsingham.

Pudibundella is as widely distributed and nearly as common as *roseosuffusella*. It is a somewhat smaller and darker species. Both species come freely to light.

Food plant.—Apple.

ARISTOTELIA MOLESTELLA Zeller.

- Gelechia (Ergatis) molestella* ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 274.
- Gelechia molestella* RILEY, Smith's List Lep. Bor. Am., No. 5412, 1891.
- Aristotelia molestella* BUSCK, Dyar's List Amer. Lep., No. 5577, 1903.

The unique type of this species is in Lord Walsingham's collection and I have not examined it; but the species can without question be referred to the present genus from Zeller's description, and Mr. J. H. Durrant has kindly substantiated this for me in a letter after examining the type.

I have identified without hesitation a single female specimen in fine condition, collected in the District of Columbia (Busck), as this species, from Zeller's careful description, which tallies in every detail with my specimen.

The type came from Texas (Belfrage).

ARISTOTELIA RUBIDELLA Clemens.

- Gelechia rubidella* CLEMENS, Proc. Acad. Nat. Sci. Phil., XII, 1860, pp. 163, 434; Proc. Ent. Soc. Phil., II, 1863, p. 121; Stainton Ed. Tin. N. Am., 1872, pp. 40, 115, 225.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5471, 1891.
- Gelechia rubensella* CHAMBERS, Can. Ent., IV, 1872, p. 193; Bull. U. S. Geol. Surv., IV, 1878, pp. 89, 147.—MURTFELDT, Can. Ent., VI, 1874, p. 222; Bull. U. S. Dept. Agr. Div. Ent., 23, 1891, p. 54.
- Gelechia pulibundella* CHAMBERS, Can. Ent., IX, 1877, p. 23.
- Gelechia (Ergatis) rubidella* WALSINGHAM, Trans. Am. Ent. Soc., X, 1882, p. 180.
- Eucatoptus rubidella* WALSINGHAM, Proc. Soc. Zool. Lond., 1897, p. 70.
- Aristotelia rubidella* DIETZ, Smith's List. Ins. N. Jersey, 1900, p. 475.—BUSCK, Dyar's List. Amer. Lep., No. 5578, 1903.

In the U. S. National Museum are two specimens determined by Lord Walsingham, one of which bears his blue label, No. 1188.

Habitat.—Eastern United States, West Indies. (Walsingham.)

ARISTOTELIA FUNGIVORELLA Clemens.

- Gelechia fungivorella* CLEMENS, Proc. Ent. Soc. Phila., III, 1864, p. 507; Stainton Ed. N. Am. Tin., 1872, p. 261.—WALSH, Proc. Ent. Soc. Phila., VI, 1866, p. 273.—PACKARD, Guide, 1870, p. 350.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 122, 143.—RILEY, Smith's List Lep. Bor. Am., No. 5367, 1891.
- ?*Gelechia salicifungiella* CLEMENS, Proc. Ent. Soc. Phila., III, 1864, p. 508; Stainton, Ed. N. Am. Tin., 1872, p. 262.—WALSH, Proc. Ent. Soc. Phila., VI, 1866, p. 273.—PACKARD, Guide, 1870, p. 350.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 122, 147.—RILEY, Smith's List Lep. Bor. Am., No. 5475, 1891.
- Aristotelia fungivorella* BUSCK, Dyar's List Amer. Lep., No. 5579, 1903.

Clemens' types in the Philadelphia Academy of Natural Sciences are lost. In the U. S. National Museum is a specimen labeled *fungivorella* by Riley and another, identical, named by Lord Walsingham.

From the mounting, the pin and the label of the Riley specimen I have a strong suspicion that it is really one of Clemens' type specimens, or at least one of the specimens originally bred by Walsh. They agree well with description. I have accidentally bred a series of what I believe is this species from willow, presumably from unnoticed cecidomid galls on the leaves in my cage. I have also beaten this same species from willow repeatedly in the vicinity of Washington.

It seems likely that *salicifungiella* bred at the same time also from willow galls, and which, according to Clemens, has the same character of markings, is only a variety of *fungivorella*, as Clemens himself suggested.

Careful and extensive breeding will here again enable definite conclusions to be drawn.

Habitat.—Illinois (Walsh); District of Columbia (Busck).

ARISTOTELIA IVÆ Busck.

Aristotelia ivæ Busck, Proc. U. S. Nat. Mus., XXII, 1900, p. 225, pl. 1, fig. 1.—
DYAR, Proc. Ent. Soc. Wash., p. 470, 1901.—Busck, Dyar's List Amer. Lep.,
No. 5580, 1903.

This species is very near to what I take to be *fungivorella* Clemens, but the knowledge of the larva and its life mode at once show the distinctiveness of the species.

Habitat.—Palm Beach, Florida (Dyar).

Food plant.—*Iva frutescens*.

Type.—No. 4932, U. S. N. M.

ARISTOTELIA BIFASCIELLA, new species.

Aristotelia bifasciella Busck, Dyar's List Amer. Lep., No. 5581, 1903.

Antennæ dark fuscous, with narrow silvery annulations. Labial palpi whitish; second joint mottled with dark brown; terminal joint with two dark brown annulations. Face, head, and thorax light ochreous. Forewings dirty yellowish white, with two conspicuous dark brown fasciæ; the first oblique from basal third of costa to middle of dorsal edge; the other is broader and nearly perpendicular on costal edge at apical third; both are shaded with lighter yellowish brown toward the dorsal edge. Just before apex is a dark brown costal spot, continued in a very light yellowish area across the wing. Extreme base of costa blackish brown. Hindwings light fuscous, cilia yellowish, Abdomen ochreous; legs whitish, with dark brown shadings on the outside; tarsi blackish brown, with tip of each joint white.

Alar expanse.—14 to 16 mm.

Habitat.—Argus Mountains, Arizona.

Type.—No. 6349, U. S. N. M.

A large easily recognized species, unlike any described American *Aristotelia*, but reminding one somewhat in size and coloration of *Epitheetis bicostomaculella* Chambers.

ARISTOTELIA ELEGANTELLA Chambers.

Gelechia elegantella CHAMBERS, Can. Ent., III, 1872, p. 239; IX, 1877, p. 23; Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5358, 1891.

Gelechia superbella CHAMBERS, Can. Ent., VII, 1875, p. 32.

Aristotelia elegantella Busck, Dyar's List Amer. Lep., No. 5582, 1903.

I have examined the types of this charming species in Cambridge; it was described from Texas, and later recorded from Missouri by Chambers. In the U. S. National Museum are specimens from Arizona and New Mexico, the latter collected by Mr. T. D. A. Cockerell. One specimen is labeled *Pu.*, but probably by mistake, as it is likely confined to southern localities. I have never seen it in the vicinity of Washington.

ARISTOTELIA ARGENTIFERA, new species.

Aristotelia argentifera Busck, Dyar's List Amer. Lep., No. 5583, 1903.

Antennæ slightly serrate toward the tip, black, with silvery-white annulations. Labial palpi, second joint light brown, with two incomplete white annulations; terminal joint blackish brown, with extreme tip and three narrow annulations white. Face whitish, tinged with brown; head and thorax light brown, intermixed with slate-colored scales. Forewings clear, deep brown, overlaid on costal half with dark, blackish brown. From near base of costa is an outwardly directed oblique white fascia, reaching nearly to dorsal margin, and edged and continued by strongly metallic silvery and bluish iridescent scales. At middle of wing is a costal white dash, continued downward and slightly inward nearly to the dorsal edge by a fascia of metallic scales. At beginning of costal cilia is a similar larger white dash, continued obliquely inward and downward by a line of metallic scales. Between the first and the second fascia is an additional smaller white costal spot, edged by metallic scales, and at the extreme apex is an ill-defined small group of white scales. From the very base of the wing outward and downward is a thin line of iridescent and silvery white scales, and single iridescent scales are found irregularly and sparsely in the other part of the wing. Cilia whitish, mixed with brown. Hindwings light silvery fuscous; cilia, with a golden-brown tint.

Abdomen brown with each joint tipped with silvery white. Legs blackish brown with silvery white bars and annulations; spurs silvery white.

Alar expanse.—10.5 to 11.5 mm.

Habitat.—San Francisco County, California.

Type.—No. 6350, U.S.N.M.

Described from 10 well-preserved specimens collected in October, probably by Mr. Koebele, judging from the elegant mounting.

I found a single specimen of this species in the Museum of Comparative Zoology in Cambridge, labeled by Lord Walsingham "*Gelechia argentifera*," which appropriate name I am pleased to adopt.

ARISTOTELIA COCKERELLA, new species.

Aristotelia cockerella Busck, Dyars List Amer. Lep., No. 5584, 1903.

Antennæ dark brown with yellow annulations. Labial palpi yellow, second joint sparsely sprinkled with black. Face, head, and thorax light greenish yellow. Basal two-thirds of forewings light yellow, concolorous with thorax; apical third dark purplish brown with a slight touch of yellow on costal edge before apex. The limit between these two colors is oblique and sharply drawn, forming a straight line from the beginning of costal cilia obliquely inward to apical two-fifths

of dorsal edge, the yellow reaching farther outward at costa and the brown reaching farther inward at dorsal edge.

On the dividing line between the two colors is an oblique row of three circular metallic golden spots edged with deep black. Cilia dark brown. Hindwings shining bluish black; cilia brown.

Abdomen deep brown above; on the underside is each joint edged by a silvery white transverse line; anal tuft yellow. Legs greenish yellow; tarsi black with white annulations.

Alar expanse.—11.5 to 12.5 mm.

Habitat.—Mesilla Park, New Mexico. (Cockerell.)

Type.—No. 6351, U.S.N.M.

Named in honor of the collector, who has sent me this exquisite species among several other *Tineina*. It is somewhat on the order of *Aristotelia elegantella* Chambers and fully as handsome.

ARISTOTELIA ABSCONDITELLA Walker.

Gelechia absconditella WALKER, Cat. Lep. Het. Br. Mus., XXIX, 1864, p. 595.—RILEY, Smith's List Lep. Bor. Am., No. 5298, 1891.

Gelechia [*Anacamptis*] *absconditella* WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 181.

Anacamptis absconditella DIETZ, Smith's List Ins. N. Jersey, 1900, p. 475.

Gelechia palpianmulella CHAMBERS, Can. Ent., IV, 1872, p. 68; Bull. U. S. Geol. Surv., IV, 1878, p. 145.

Aristotelia absconditella BUSCK, Dyar's List Amer. Lep., No. 5585, 1903.

Chambers's types of this species in Cambridge are identical with a large bred series in U. S. National Museum, determined by Lord Walsingham. The larvæ live in the stems of *Polygonum acre*, causing a slight swelling at the joints, and are found very commonly in the vicinity of Washington. Frequently every joint of a plant contains a larva. The species overwinters in the stems as larvæ, and the moths issue during May and June. It is of interest to note that the peculiar shining color of this species is identical with that of another polygonum feeding Tineid, *Gelechia discooceliella* Chambers.

The superficial resemblance to the *tenionella* group of Europe has induced Lord Walsingham, and subsequently Dr. Dietz, to place this species in *Approvema* Durrant (*Anacamptis* auct.), but the venation shows that it belongs to the present genus.

This species has been bred in the insectary of U. S. Department of Agriculture under the number 3373.

Under No. 4575 has been reared another large series of *Aristotelia* from the roots of *Ampelopsis quinquefolia*, received from Mr. G. Barlow, Cadet, Missouri, and issued in March and April, 1890.

These moths average a trifle larger than those bred from *Polygonum*, but I can not otherwise distinguish them, and am forced, at present at least, to place them under this species in spite of the improbability that one species should have both food plants. Possibly some mistake

may have taken place in the record. Even the minute characteristics of the antennæ and palpi, pointed out by Lord Walsingham in *absconditella*, are found identically in the specimens bred from *Ampelopsis*.

I have seen specimens of this species from New Jersey, Pennsylvania, Maryland, District of Columbia, Virginia, West Virginia, and Missouri.

ARISTOTELIA MINIMELLA Chambers.

Gelechia minimella CHAMBERS, Can. Ent., VI, 1874, p. 243; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5411, 1891.

Aristotelia minimella BUSCK, Dyar's List Amer. Lep., No. 5586, 1903.

Type no. 455 in the U. S. National Museum, labeled by Chambers and received from him as type of *Gelechia minimella*, is, together with two similar types in Cambridge, the only authentic material left by Chambers of this species.

All three are in bad condition, but I have saved for posterity the loose wings of one side of the type in the National Museum on a slide, which, under the microscope, shows that the specimen is a true *Aristotelia*.

I believe that the Cambridge specimens are identical, but their condition does not permit certainty. However, under the circumstances I feel justified to hold the National Museum specimen as the type, thus enabling us to put down the species as a known quantity instead of as an uncertain, name belonging to a valueless description.

I have received specimens of this *Aristotelia* reared from oak by Miss Mary Murtfeldt at Kirkwood, Missouri.

The types are from Texas. In the National Museum are specimens from New Jersey (Kearfott) and District of Columbia (Busck).

ARISTOTELIA PHYSALIELLA Chambers.

Gelechia physaliella CHAMBERS, Can. Ent., IV, 1872, p. 173; Cinn. Quart. Jour. Sc., II, 1875, p. 238; Bull. U. S. Geol. Surv., III, 1877, p. 128; IV, 1878, pp. 117, 145.—RILEY, Smith's List Lep. Bor. Am., No. 5446, 1891.

Aristotelia physaliella BUSCK, Dyar's List Amer. Lep., No. 5587, 1903.

Type No. 457 in the U. S. National Museum, received from Chambers and labeled in his handwriting, undoubtedly represent this species. I have met with no other specimens in other collections.

Habitat.—Kentucky, Arizona. (Chambers.)

Food plant.—*Physalis viscosa*. (Chambers.)

ARISTOTELIA DISCONOTELLA Chambers.

Gelechia disconotella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 86, 143.—RILEY, Smith's List Lep. Bor. Am., No. 5354, 1891.

Aristotelia disconotella BUSCK, Dyar's List Amer. Lep., No. 5588, 1903.

The type of this species with Chambers' handwriting on the label

is in the Museum of Comparative Zoology. It is in fairly good condition and agrees well with his description.

In the National Museum is a perfect specimen, bred by Mr. F. C. Pratt from stem of raspberry, June 2, 1898.

Habitat.—Kentucky (Chambers). District of Columbia (Pratt).

ARISTOTELIA GILVOLINIELLA Clemens.

Gelechia gilvoliniella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, p. 119; Stainton Ed. N. Am. Tin., 1872, pp. 223, 224.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's Hist. Lep. Bor. Am., No. 5380, 1891.
Aristotelia gilvoliniella BUSCK, Dyar's List Amer. Lep., No. 5589, 1903.

The type of this species is lost, but from Dr. William Dietz I have received a specimen, which he has determined as *gilvoliniella*, and which I have no doubt really represents this species. It agrees well with description and is a typical *Aristotelia*.

The specimen in National Museum, as well as others in Dr. Dietz's collection, were collected in Pennsylvania, where presumably Clemens also found his type.

ARISTOTELIA KEARFOTTELLA, new species.

Aristotelia kearfottella BUSCK, Dyar's List Amer. Lep., No. 5590, 1903.

Antennæ fuscous, silvery white at base. Labial palpi silvery white; second joint with a black bar on the outside; terminal joint longer than second joint, with tip black. Face, head, and thorax silvery white. Forewings at base silvery white, gradually becoming overlaid with fuscous outward; outer half of wing dark fuscous with a silvery yellowish luster. At the end of the cell is a small round black dot. At beginning of costal cilia is a short oblique triangular light yellow spot. At base of cilia, round the entire apical edge, is a heavy deep black line, interrupted by four costal and three dorsal short indistinct yellowish-white dashes, which are faintly continued out in the dark fuscous cilia. Dorsal edge opposite the costal triangular spot yellowish. The underside of the forewings is uniformly dark, shining fuscous, with the costal spot and the apical streaks of yellow faintly indicated.

Hindwings dark fuscous, nearly black, with silvery reflexions; cilia dark steel-gray; abdomen dark gray; legs silvery white; tuft on hind tibiae yellowish; tarsi shaded with fuscous.

Alar expanse.—12 mm.

Habitat.—Pennsylvania, New Jersey.

Type.—No. 6352, U.S.N.M.

Cotypes are in the collection of Mr. William D. Kearfott, in honor of whom I name this species and from whom the National Museum has obtained its specimens.

ARISTOTELIA QUINQUEPUNCTELLA, new species.

Aristotelia quinquepunctella Busck, Dyar's List Amer. Lep., No. 5591, 1903.

Antennæ light yellowish brown, annulated with white. Labial palpi, second joint fuscous with white apex; terminal joint yellow with fuscous shading toward the tip. Face yellowish white. Head and thorax yellow. Forewings pale whitish yellow, sparsely sprinkled with fuscous on disk, more strongly overlaid with fuscous along the edges and gradually more so toward the tip, which is quite dark. On the disk are four nearly equidistant black prominent dots forming a rhomb; one within the costal edge at basal third, one opposite a little farther outward, within dorsal margin on the fold, a third also on the fold near base, and the fourth on the middle of the wing. A fifth similar black spot is found just outside the end of the cell at the same distance from point four as that between the other dots. Cilia yellow with an indistinct dark line at base parallel with the edge of the wing. Hindwings light silvery fuscous. Cilia dark yellowish fuscous. Abdomen dark fuscous. Legs yellowish, shaded with fuscous; anterior coxæ in front dark fuscous.

Alar expanse.—11.5 mm.

Habitat.—Pennsylvania (June).

Type.—No. 6353, U.S.N.M.

The moth has a certain general resemblance with *Trichotaphe trimaculella* Chambers. I have tried to reconcile this species with the description of the unrecognized *Gelechia punctiferella* Clemens, which seems to be a similar species, but without success.

HELICE Chambers.

Plate XXIX, fig. 12.

Helice CHAMBERS, Can. Ent., V, 1873, p. 187.

Labial palpi very long, smooth, curved; second joint somewhat thickened toward apex with appressed scales; terminal joint longer than second, slender, pointed.

Forewings narrow, elongate ovate, pointed; 11 veins, 5 absent, 7 and 8 out of 6, 3 and 4 stalked. Hindwings narrower than forewings, apex produced pointed, termen emarginate, anal angle rounded; 6 veins, 5 and 6 absent, 3 and 4 stalked, transverse vein obsolete. Forewing with tufts of raised scales.

Only the one species is known.

HELICE PALLIDOCHELLEA Chambers.

Helice pallidochrella CHAMBERS, Can. Ent., V, 1873, pp. 188, 230; VII, 1875, p. 105; IX, 1877, p. 231; Bull. U. S. Geol. Surv., IV, 1878, p. 150.—Busck, Journ. N. Y. Ent. Soc., X, 1902, p. 89; Dyar's List Amer. Lep., No. 5592, 1903.

Helice pallidochrella CHAMBERS, Can. Ent., IX, 1877, p. 15.

Helice gleditschiella CHAMBERS, Can. Ent., IX, 1877, p. 232.

Gelechia gleditschiella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., 1891, p. 113.

Not *Helice pallidochrella* WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 188.—MURTFELDT, Can. Ent., XV, 1883, p. 95.

I have given a full review of this species, types of which are in the Museum of Comparative Zoology and in U. S. National Museum.

Habitat.—Kentucky.

EVIPPE Chambers.

(Plate XXIX, fig. 13.)

Erippe CHAMBERS, Can. Ent., V, 1873, p. 185.

Phatusa CHAMBERS, Can. Ent., VII, 1875, p. 106.

Labial palpi long recurved, nearly smooth, second joint somewhat thickened beneath, terminal joint slender, pointed, nearly as long as second joint. Forewings elongate ovate, pointed, 12 veins, 7 and 8 out of 6, 4 and 5 connate, or short stalked, rest separate.

Hindwings nearly as broad as forewings, trapezoidal, apex produced, pointed, termen sinuate; 7 veins, 6 absent, 7 to costa just before apex, 3 and 4 connate, 5 approximate to 4, 2 distant. Cell not closed between 5 and 7.

Chambers's types of the types of both genera are in the U. S. National Museum and prove that they are congeneric. Chambers compared generically and specifically his *Phatusa plutella* with *Erippe prunifoliella* saying:

The only reason for separation is found in the neuration. The other characters are those of *Erippe*, and it (*plutella*) is very near to *prunifoliella* in ornamentation.¹

But he contradicts himself in trying to show the supposed differences in venation by writing that

The last branch of median vein in forewing of *Erippe* is simple, while in the original description of that genus he says:

Median becomes furcate behind the cell.

And this he repeats while describing his genus *Eidothoa*.²

The latter statement is correct, and thus it is also in *Phatusa*, as stated by Chambers.

The only other differences in venation pointed out by Chambers are in the hindwings, where he thought that vein 6 and discal nervure is present in *Phatusa* while absent in *Erippe*. It is easy to see, with a perfect side of the wing before one, how the fold has misled Chambers to see a vein 6, which really is not present, and a similar mistake

¹Can. Ent., VII, p. 106.

²Idem., V, p. 187.

about the discal vein is quite natural, considering how rather crude his way of denuding such very small and delicate wings was.¹

Thus the name *Phatusa*, which was preoccupied anyway, must be dropped as synonymous with *Evippe*.

Lord Walsingham suggested² that the two species even were identical, but Chambers³ wrote that he could not agree to that view, and the two types in U. S. National Museum, as well as his types in Cambridge, support Chambers. They surely represent two good species, which may be separated thus:

With white costal spot..... *prunifoliella*
Without white costal spot..... *leuconota*

EVIPPE PRUNIFOLIELLA Chambers.

Evippe prunifoliella CHAMBERS, Can. Ent., V, 1873, p. 186; VII, 1875, p. 105; IX, 1877, p. 23; Bull. U. S. Geol. Surv., IV, 1878, pp. 112, 141.—BUSCK, Dyar's List Amer. Lep., No. 5593, 1903.

Gelechia prunifoliella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 146.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 177.—MURTFELDT (Chambers quoted), Can. Ent., XV, 1883, p. 94.—RILEY, Smith's List Lep. Bor. Am., No. 5452, 1891.

An authentic specimen received from Chambers and with his label on the pin is in U. S. National Museum. Also several other specimens, bred from *Prunus* by Miss Murtfeldt, from peach by Mr. Chambliss and from both by the writer.

Habitat.—Kentucky (Chambers), Missouri (Murtfeldt), Tennessee (Chambliss), District of Columbia (Busek).

EVIPPE LEUCONOTA Zeller.

Gelechia [Teleia] leuconota ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 268, pl. III, fig. 21.

Gelechia leuconota CHAMBERS, Bull. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5401, 1891.

Phatusa plutella CHAMBERS, Can. Ent., VII, 1875, p. 106; Bull. U. S. Geol. Surv., IV, 1878, p. 160.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 177.—MURTFELDT, Can. Ent., XV, 1883, p. 94.—RILEY, Smith's List Lep. Bor. Am., No. 1512, 1891.

Evippe leuconota BUSCK, Dyar's List Amer. Lep., No. 5594, 1903.

Chambers himself suggested the above synonymy, and his type of *Phatusa plutella* in the U. S. National Museum (No. 466) proved on comparison with Zeller's type of *Gelechia leuconota* in the Museum of Comparative Zoology to be identical.

Habitat.—Texas.

¹Can. Ent., IV, p. 41.

²Trans. Am. Ent. Soc. Phila., X, 1882, p. 177.

³Through Miss Murtfeldt, Can. Ent., XV, p. 94-95.

EUCORDYLEA Dietz.

Plate XXIX, fig. 14.

Eucordylea DIETZ, Ent. News, XI, 1900, p. 349.

Labial palpi large, robust, second joint with dense expansible tuft of long hairs on the upper side, terminal joint shorter than second, smooth, pointed.

Forewings elongate, narrow, dorsal edge slightly sinuate at vein 2, apex obtusely pointed; 12 veins, 7 and 8 out of 6; 3, 4, and 5 long, approximate from lower corner of cell; 2 distant, short. Hindwings trapezoidal, apex blunt, termen slightly bisinuate; 8 veins, 3 and 4 nearly connate, 5 approximate to 4, 6 and 7 connate.

This genus is a specialized development from *Recurvaria* Haworth, easily recognized by the peculiar palpi.

Only the one species is described; in Dr. Dietz's collection is another, smaller, mottled-gray species, which he kindly offered the writer for description, but it is not, in my judgment, in sufficiently good condition to describe.

I am under obligation to Dr. Dietz for his liberal permission to make a slide of his unique type specimen in order to determine the venation with certainty. The figure is made from this type slide.

EUCORDYLEA ATRUPICTELLA Dietz.

Eucordylea atrupictella DIETZ, Ent. News, XI, 1900, p. 350, pl. 1, figs. 1 and 1a.—
BUSCK, Dyar's List Amer. Lep., No. 5595, 1903.

I have had opportunity to study carefully the type of this species in Dr. Dietz's collection; it is a male. In the U. S. National Museum is another perfect male specimen, received from A. W. Hanham, collected in Ontario, Canada; the type is from Pennsylvania.

RECURVARIA Haworth.

Plate XXIX, fig. 15.

Recurvaria HAWORTH, Lep. Brit. Lond., 1829, p. 547.*Eragora* CLEMENS, Proc. Acad. Nat. Sc. Phila., 1860, p. 165.*Eidothoa* CHAMBERS, Can. Ent., V, 1873, p. 186.*Sinoë* CHAMBERS, Can. Ent., V, 1873, p. 231.*Aphananthe* MEYRICK, Handbook Br. Lep., 1895, p. 579.Not *Recurvaria* (Haworth) MEYRICK, Handbook Br. Lep., 1895, p. 606.

Labial palpi slightly thickened, with rough scales beneath; terminal joint pointed, shorter than second joint. Forewings elongate, narrow, pointed, dorsal edge slightly sinuate at vein 2; 12 veins, 7 and 8 out of 6; 3, 4, 5 long, approximate from end of cell, 2 short, separate. Hindwings narrower than forewings, trapezoidal, apex produced, pointed, termen sinuate; 8 veins, 3 and 4 connate, 5 approximate to 4, 6 and 7 approximate. Forewings often with raised scales. The males of several of the American species have the costal hair pencil at base of

hindwing, which Zeller mentions in his species, belonging to this genus and which Lord Walsingham regarded as of generic value.¹

I have before (p. 771) given the reasons why I can not agree with him in this.

Clemens's careful definition of *Eragora apicitripunctella* does not leave any doubt about the generic characters of that species, even if there may be some differences of opinion about the identification of the species (p. 809).

The type of Chambers's genus *Sinoë* is *fuscopallidella*, of which the unique type is in the Museum of Comparative Zoology. This is in very poor condition, but shows positively that its generic characters are the same as those of *Eragora* and of the two European species, *nanella* Hübner and *leucatella* Linnaeus, at present included by Staudinger and Rebel in *Recurvaria* as now restricted (*Aphanaula* Meyrick).

The type of Chambers's genus *Eidothou*, *vagationella*, I regard as synonymous with Zeller's *Gelechia dorsivittella*, which also belongs to the present genus.

The recognized species of *Recurvaria* in America may be separated by the following table:

Forewings more or less ochreous	1
Forewings not ochreous	4
1. Labial palpi pure white.....	<i>variella</i> , p. 809
Labial palpi with dark markings	2
2. Forewings with distinct row of black dots on costal apical edge	3
Forewings without such distinct dots	<i>obliquestrigella</i> , p. 811
3. Forewings with indistinct angulated whitish fascia.....	<i>apicitripunctella</i> , p. 808
Forewings without such fascia	<i>colobrinæ</i> , p. 810
4. Forewings very dark, nearly unicolorous.....	<i>nigra</i> , p. 814
Forewings lighter, not unicolorous	5
5. Forewings with oblique pronounced costal white streak at basal third.....	<i>cristatella</i> , p. 814
Forewings without such pronounced streak	6
6. Forewings with black dorsal patch near base.....	<i>robinella</i> , p. 812
Forewings without such patch	7
7. Dorsal edge of wings pure white.....	<i>dorsivittella</i> , p. 813
Dorsal edge not white	8
8. Males with costal hair pencil at base of hindwing	<i>quercivorella</i> , p. 813
Males without such hair pencil.....	<i>cratagella</i> , p. 811

RECURVARIA APICITRIPUNCTELLA Clemens.

Eragora apicitripunctella CLEMENS, Proc. Acad. Nat. Hist. Phila., 1860, p. 165; Stainton Ed. No. Am. Tin., 1872, p. 120.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5297, 1891.

Gelechia (Eragora) apicitripunctella WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 182.

Gelechia abietisella PACKARD, U. S. Dept. Agr. Rep., 1883, p. 150, pl. III, fig. 2; pl. XIII, fig. 7; Rep. U. S. Ent. Comm., 1890, p. 876, pl. IX, fig. 2; pl. XXVI, fig. 7.

Recurvaria apicitripunctella BUSCK, Dyar's List Amer. Lep., No. 5596, 1903.

¹Proc. Zool. Soc. Lond., 1897, p. 64.

While there is no difficulty about the identity of Clemens's genus, it is not quite so satisfactory with the specific identity of his type of the genus.

Lord Walsingham placed it as synonymous with Zeller's *gilvoscopella*, and as Clemens' type is not in existence it is difficult to prove or disprove the identity absolutely, and I should have left it on Walsingham's authority, even though the synonymy seemed very strange from the quite different descriptions of the two species, if I had not been able to examine the evidence on which Lord Walsingham based his opinion in 1882.

These specimens (labeled with Lord Walsingham's blue labels, nos. 148, 149, and 150, corresponding to his identification in his notebook¹), are in Professor Fernald's collection, and they surely are not the same as the type of Zeller's *gilvoscopella*, preserved in excellent condition in the Museum of Comparative Zoology.

They are in rather poor condition, but agree as far as can be made out with undoubted specimen of *abictisella* Packard, a large, bred series of which is in the U. S. National Museum.

Here also are to be found two specimens labeled in Lord Walsingham's handwriting *apicitripunctella*, one determined in 1887 and one in 1891. The first is bred from locust and is *robinella* Fitch (p. 812), and the other is the same as the specimens in Professor Fernald's collection and is *abictisella* Packard.

That Lord Walsingham at that time, with the limited material at his command, was not very certain about these nearly related, similar species is shown by his suggestion² that *dorsivittella* Zeller and *crustatella* Chambers might also be mere varieties of *apicitripunctella*.

Clemens's description agrees well with *abictisella*, but can not be reconciled with Zeller's description of *gilvoscopella*, the one belonging to the ochreous group, the other to the fuscous.

While, then, absolute proof about this species can not be obtained because the type is lost, it seems evident to me, after careful analysis of the different descriptions and with large series of mostly bred specimens of all these allied species before me, that *apicitripunctella* (1) can not be Zeller's *gilvoscopella*, and (2) can not be any other species than Packard's *abictisella*.

Food plant.—*Abies canadensis*.

The males have the hair pencil at base of the hindwings.

RECURVARIA VARIELLA Chambers.

Gelechia variella CHAMBERS, Can. Ent., IV, 1872, p. 174; VI, 1874, p. 241; Bull. U. S. Geol. Surv., IV, 1878, p. 148.—RILEY, Smith's List Lep. Bor. Am., No. 5507, 1891.

Recurvaria variella BUSCK, Dyar's List Amer. Lep., No. 5597, 1902.

¹See preface, p. 768.

²Trans. Am. Ent. Soc. Phila., X, p. 182.

Type No. 465 in the U. S. National Museum of this species, received from Chambers with his handwriting on the label, is identical with types in the Museum of Comparative Zoology in Cambridge.

They are in very poor condition, but agree well with description, and unquestionably represent this species. A slide of the wings made from the one side of the National Museum type, for the double purpose of preserving and studying the species, shows that it belongs in the present genus.

I have bred a large series of these moth from bald cypress (*Taxodium distinctum*) on grounds of the U. S. Department of Agriculture, Washington, District of Columbia. The larvæ work in the same way as *apictripunctella* on hemlock, uniting a few needles and feeding between them. The pupa is also found in silk lined tubes formed of a few needles. Several generations occur during the summer, the imagoes of one of which are very abundant in early July.

RECURVARIA COLUBRINÆ, new species.

Recurvaria colubrinæ Busck, Dyar's List Amer. Lep., No. 5598, 1902.

Antennæ light brown with white annulations. Labial palpi with second joint light brown, white at apex; terminal joint white with a broad brown annulation round middle and a narrow one just before the tip.

Face, head, and thorax reddish white with scattered light-brown scales. Forewings dirty ochreous white, outer half suffused with light fuscous. On costa are three equidistant brown spots, one near base, one at middle, and one at the beginning of costal cilia. In the middle of the wing are three small brown spots in a straight longitudinal line, one at basal third, one at middle of wing, and one at the end of the cell. Just within the dorsal cilia are two large ill-defined longitudinal brown spots, and at apical edge is a row of dark dots.

Cilia whitish, mixed toward apex with fuscous. Hindwing silvery fuscous, cilia yellowish. Legs dark brown with white annulations; posterior tibial above yellowish white.

Alar expanse.—10 mm.

Type.—No. 6354, U.S.N.M.

This moth was bred in the insectary of U. S. Department of Agriculture by Mr. Th. Pergande, from *Psylla* galls on *Colubrina texensis* received from Mr. E. A. Schwarz, from Rockport, Texas, August, 1894.

Mr. Pergande writes in the notebook on this species under no. 6336:

Found in *Psylla* galls on *Colubrina texana*, a small Tineid larva of a yellowish white color with the incisions between the segments pinkish and the head and cervical shield yellow. This larva feeds upon the *Psyllids*; there were also found within the galls a few pupæ belonging to this larva.

Although unwilling to doubt so careful and trained an observer as Mr. Pergande, I would say that the generic relations of the species

indicate that the Psyllid-galls were merely used as an accidental convenient retreat for pupation and that the species probably is a vegetable feeder as the other species of the genus, whose life histories are known.

RECURVARIA OBLIQUISTRIGELLA Chambers.

Anarsia obliquistrigella CHAMBERS, Can. Ent., IV, 1872, p. 65.

Gelechia obliquistrigella CHAMBERS, Can. Ent., IV, 1872, p. 175; VII, 1875, p. 106; IX, 1877, p. 24; X, 1878, p. 50; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5422, 1891.

Recurvaria obliquistrigella BUSCK, Dyar's List Amer. Lep., No. 5599, 1902.

Not *Gelechia obliquistrigella* PACKARD, U. S. Ent. Comm. Rep., V, 1890, p. 850, fig. 284.

In Professor Fernald's collection I have examined several specimens received from Chambers as this species and identified by Lord Walsingham in 1882 as *obliquistrigella*. One of these I obtained through the kindness of Professor Fernald for the U. S. National Museum. They are identical with the type in the Museum of Comparative Zoology, as far as the miserable condition of this latter permits identification. At least they agree generically and belong to the present genus. These specimens agree tolerably well with Chambers's description.

Packard¹ figures a *Gelechia*, bred from spruce and which had been determined by Professor Fernald as *Gelechia obliquistrigella*.

But the species figured is surely not the present species, agreeing neither with the types nor with the description of *obliquistrigella*, the food plant of which must for the present stand unknown.

This species has not the hair pencil at base of hindwing in the males.

RECURVARIA CRATAEGELLA, new species.

Recurvaria crataegella BUSCK, Dyar's List Amer. Lep., No. 5600, 1902.

? *Recurvaria nanella* HÜBNER, Standinger and Rebel Cat. Eur. Lep., II, No. 2874, 1901.

Antennae whitish with indistinct narrow dark-brown annulations. Labial palpi whitish with two black annulations on each joint, tip white. Face, head, and thorax white suffused with fuscous.

Forewings white thickly sprinkled with fuscous. From near the base of costa is an outwardly directed oblique ill-defined black streak, not reaching to the dorsal edge, more or less interrupted at the fold and bordered on the outside with white scales. From middle of costa is a similar, parallel, interrupted dark streak still less clearly defined. At the end of the cell in middle of wing is a short black longitudinal streak; below this on dorsal edge is a small black spot and on costal edge is two similar black spots, one at apical third, the other just

¹U. S. Ent. Comm. Report, V, p. 850, fig. 284.

before apex. Cilia white, speckled black, and fuscous. Hindwings light silvery fuscous, cilia a shade lighter than wing; male without costal hairpencil.

Abdomen dark fuscous, anal tuft silvery gray; legs white with black annulations; hairs on posterior tibia silvery white. Alar expanse, 12 mm.

Type.—No. 6355, U.S.N.M.

Bred by Dr. William Dietz in Hazleton, Pennsylvania, from *Cratægus tomentosus* in June, but without any notes on the larva or its habit.

The species is very near the other fuscous species of the genus and easily mixed with *cristatella* Chambers, but besides minor colorational differences, it differs in the lack of hairpencil at base of hindwings in the male.

I am, at present, unable to separate this species from a series of authentic European specimens of *Recurvaria nanella* Hübner, and I am conscious of the probability of my making a synonym of this species, the life history of which, according to Meyrick's Handbook of British Lepidoptera, is not definitely known, but which is variously said to feed in flowers or in shoots of pear or on lichens growing on the trunk.

As long as definite knowledge of the larva of both species is lacking, I regard it a much better policy to treat the American form as a distinct species, instead of running the risk of wrongly recording European species in America, which has already been done, too hastily in my opinion, in other groups of *Tineinæ*. Such records are very difficult to disprove, and, if wrong, not only encumber our lists and tables, but give false ideas of geographical distribution.

RECURVARIA ROBINIELLA Fitch.

Anacampsis robinella FITCH, Rep. Nox. Benef. Insects N. York, V, 1859, p. 835.—CHAMBERS, Can. Ent., III, 1871, pp. 163, 183.

Gelechia robinella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5469, 1891.

Sinoë fuscopallidella CHAMBERS, Can. Ent., V, 1873, p. 231; VII, 1875, pp. 105, 106.

Gelechia (Sinoë) fuscopallidella CHAMBERS, Can. Ent., IX, 1877, p. 24; Rep. U. S. Dept. Agr., 1879, p. 225.

Gelechia fuscopallidella CHAMBERS, Bull. U. S. Geol. Surv., 1878, IV, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5371, 1891.

Gelechia robiniaefoliella CHAMBERS, Rep. U. S. Dept. Agr., p. 224, 1879.

Recurvaria robinella BUSCK, Dyar's List Am. Lep., No. 5601, 1902.

As already realized by Chambers, Fitch evidently made a mistake in associating his moth described as *Anacampsis robinella* with the larva and mine described under that name. This is clear, as he could not breed a moth with alar expanse 0.45 inch from a full-grown larva only 0.18 inch long.

Fitch collected his *Robinia* leaves in the autumn and in the spring his moth appeared, so it seems reasonable that some other larger larva

have been present, unnoticed by Fitch, from which the moth came, which he associated with the larva and mine, he had taken notes on the previous fall. His description of the moth is not very satisfactory, but there is no other species feeding on Robinia but the present of about the size he gives, and it is reasonably certain that this is the species he had under consideration.

Chambers's type of *Sina fuscopallidella* I have examined in the Museum of Comparative Zoology. It is in very poor condition, but agrees well with the description as far as could be made out, and shows positively that its generic characters are identical with those of *Eragora* Clemens, and also that it is specifically identical with the common Robinia-feeding species, which Chambers later described as *Gelechia robiniaefoliella*, he himself suggesting that it was the same species as previously described by him as *fuscopallidella*.

A large bred series is in U. S. National Museum.

The males have no hairpencil at base of hindwing.

Habitat.—Texas, Kentucky, eastern United States.

RECURVARIA QUERCIVORELLA Chambers.

Gelechia quercivorella CHAMBERS, Can. Ent., IV, 1872, p. 173; Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5462, 1891.

Gelechia (Teleia) gilviscopella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 266.

Gelechia gilviscopella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5297 (part) 1891.

Recurvaria quercivorella BUSCK, Dyar's List Amer. Lep., No. 5602, 1903.

Zeller's two types (males) of *gilviscopella* in the museum in Cambridge are in perfect condition and show this species to be a much larger and darker species than Clemens *apictripunctella*. Identical specimens in large series are in U. S. National Museum. The type in Cambridge of Chambers *quercivorella* is in miserable condition, consisting only of head with palpi, thorax, and one forewing. It is, however, undoubtedly a *Recurvaria*, and I have no hesitancy, after careful comparison with Zeller's types of *gilviscopella*, to determine it as the same as this species, which is also an Oak-feeder.

Chambers' name must take precedence.

Habitat.—Kentucky, Texas, eastern United States.

RECURVARIA DORSIVITTELLA Zeller.

Gelechia (Tellia?) dorsivittella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 267, pl. III, fig. 20.

Gelechia dorsivittella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5357, 1891.

Aristotelia dorsivittella WALSINGHAM, Proc. Zool. Soc. Lond., 1897, p. 66.

Aristotelia dorsivittella DIETZ, Smith's List Ins. N. Jersey, 1900, p. 475.

Eidothoa vagatiolla CHAMBERS, Can. Ent., V, 1873, p. 187; VII, 1875, p. 105.

Gelechia vagatioella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5505, 1891.

Recurvaria dorsivittella BUSCK, Dyar's List Amer. Lep., No. 5603, 1903.

Type of *dorsivittella* was found in the museum in Cambridge in good condition in May, 1900, and agrees with a specimen determined by Lord Walsingham in the U. S. National Museum.

I assume the synonymy of Chambers' *vagatioella*, which seems reasonably certain from the generic and specific descriptions of that species, all authentic material of which is lost.

Habitat.—Texas, Kentucky, Eastern United States, West Indies.

RECURVARIA CRISTATELLA Chambers.

Gelechia cristatella CHAMBERS, Cimn. Quart. Journ. Sc., II, 1875, p. 241; Bull. U. S. Geol. Surv., IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5346, 1891.

Gelechia (Eragora) cristatella WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, pp. 179, 182.

Recurvaria cristatella BUSCK, Dyar's List Amer. Lep., No. 5604, 1903.

Type No. 449 in the U. S. National Museum, received from Chambers, is identical with four types examined by the writer in the Museum of Comparative Zoology.

The former is a male and has the yellow hair pencil on hindwing; so have the males in Cambridge. No other specimens are known to me.

Habitat.—Kentucky.

RECURVARIA NIGRA, new species.

Recurvaria nigra BUSCK, Dyar's List Amer. Lep., No. 5605, 1903.

Antennæ black, with indistinct narrow silvery annulations. Labial palpi with second joint black except at apex, which is silvery white; terminal joint white, with two broad black annulations; extreme tip white.

Face, head, and thorax black, with purplish reflections. Ground color of forewings silvery white, but so thickly overlaid with black and dark fuscous scales as to appear black to the naked eye. Under a lens is indistinctly seen six deep black spots of raised scales in two rows, one above, the other below fold. At apical fourth is a very narrow, irregular, V-shaped, silvery white fascia, with the angle pointed toward the tip of the wing, and farther out toward apex is a very indistinct thin row of white scales, parallel with the costal edge and meeting a similar line parallel to the dorsal edge just before apex. Cilia dark gray. Hindwings nearly black, with metallic luster. Legs black, with white annulations; tuft on posterior tibiæ silvery white.

Alar expanse.—11 mm.

Habitat.—District of Columbia.

Type.—No. 6356, U.S.N.M.

The larva feeds presumably on *Hypericum fruticosum*, but was not observed. The moth was reared accidentally May 5, in a jar containing another Tineid under observation on the above plant.

TRYPANISMA Clemens.

Plate XXIX, fig. 16.

Trypanisma CLEMENS, Proc. Ent. Soc. Phila., 1860, p. 168; N. A. Tineina, 1872, p. 125.

With his usual care Dr. Clemens characterized this genus, so that it can be readily and unquestionably recognized even with the type lost.

It has the labial palpi moderate, second joint slightly thickened, with rough scales beneath, terminal joint as long as second, rather thick, but smooth and pointed. Forewings elongate, pointed; 12 veins, 7 and 8 out of 6, 3 and 4 stalked; hindwings a little narrower than forewings, apex produced, termen emarginate; 8 veins, 3 and 4 connate, 5 approximate to 4, 6, and 7 stalked.

It was interesting to discover a new species of this genus with identical habits and structure.

The two known species can be thus separated:

- Head and face white *fagella*, p. 816
- Head and face suffused with fuscous *prudens*, p. 815

TRYPANISMA PRUDENS Clemens.

Trypanisma prudens CLEMENS, Proc. Ent. Soc. Phila., 1860, p. 168; Stainton Ed. Tin. N. Am., 1872, p. 125.—CHAMBERS, Can. Ent., V, 1873, p. 188.—RILEY, Smith's List Lep. Bor. Am., No. 5589, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5606, 1903.

Tripanisma prudens CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 166.

Gelechia quinqueannulata CHAMBERS, Can. Ent., IV, 1872, p. 191; Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5464, 1891.

Clemens's type is lost, but I had no difficulty in positively identifying his species by rearing the characteristic larva, which feeds on the upperside of oak leaves under a thin sheet of silk, with a safety exit to the underside of the leaf, as Clemens described.

These bred moths, now in U. S. National Museum, agree perfectly, generically and specifically with Clemens' description, and represent without doubt the species.

They were carefully compared with and found identical with Chambers' type of *Gelechia quinqueannulata* in the Museum of Comparative Zoology in Cambridge, which, furnished with Chambers' label, was found sufficiently well preserved to be easily recognizable, and which agreed with his description.

Chambers' notes on the early stages further verifies this synonymy. Chambers wrote that he was not acquainted with *Trypanisma prudens*.¹

Habitat.—Pennsylvania, District of Columbia.

¹Can. Ent., V, p. 188.

TRYPANISMA FAGELLA, new species.

Trypanisma fagella Busck, Dyar's List Amer. Lep., No. 5607, 1902.

Antennæ dark, fuscous, annulated with white. Labial palpi whitish, with a black annulation at base of terminal joint and one just before the tip. Face and head white, thorax light gray.

Ground color of forewings yellowish white, but thickly suffused with black and gray scales, so that the wings look light gray to the naked eye. At the middle of the cell is a circular group of dense black scales, followed by a patch of yellow, with only slight dark sprinkling. At beginning of costal cilia is a nearly black large outwardly directed streak, and on the dorsal side opposite a small corresponding black patch. These black markings are edged broadly on the outside with unsprinkled yellow.

Hindwing and cilia light silvery gray. Abdomen silvery gray. Legs on the outside barred with black and silvery yellow, on the inside silvery gray.

Alar expanse.—9 mm.

Habitat.—District of Columbia.

Type.—No. 6357, U.S.N.M.

The larva is similar to and feeds in the same manner as *T. prudens*, but has as food plant beech. Like the oak feeder, it pupates in a slight web on the underside of the leaf, which is drawn into a shallow fold.

The moth is generically identical with the type of the genus and resembles it in size and general appearance, but it is a much lighter species.

EPITHECTIS Meyrick.

Plate XXX, fig. 17.

Epitheatis MEYRICK, Handbook Brit. Lepidoptera, 1895, p. 580.

Taygete CHAMBERS (not *Taygetis* Hübner), Can. Entomologist, V, 1873, p. 231.

Purasia CLEMENS (not Duponchel), Proc. Acad. Nat. Sci. Phil., 1860, p. 173.

Meyrick's definition of this genus is as follows:

Second joint of labial palpi thickened with rough scales beneath, terminal nearly as long as second, somewhat roughened anteriorly. Forewings elongate, pointed, 7 and 8 out of 6. Hindwings I, trapezoidal, apex pointed, termen somewhat sinuate, cilia I; 3 and 4 connate, 5 somewhat approximate, 6 and 7 stalked.

A series of *attributella* Walker (*difficilisella* Chambers), type of Chambers' genus *Taygete* was submitted to Dr. Meyrick, who unhesitatingly pronounced his genus *Epitheatis* a synonym of Chambers's genus.

As, however, the name *Taygete* is preoccupied, Meyrick's later name will stand, and the genus must be included in the American fauna.

I have not personally examined any European species of the genus.

but that is superfluous after such an authoritative determination. Some of the American species have a tendency for veins 3 and 4 in hindwing to become short-stalked instead of connate and have the discal vein nearly obsolete. Some of the species present a character, which is noteworthy and which I do not know whether it is found in the European forms—at least, it is not noted by Mr. Meyrick in his generic synopsis—namely, the long-stalked veins 6 and 7 in the hindwing, which both go to the costal edge, not, as might be expected, inclosing the apex.

I am acquainted with the following species, which may be separated thus :

Forewings with black dash at tornus	4 <i>subsimella</i> , p. 819
Forewings without such dash	1
1. Entire wing overlaid with dark scales	2
Wing light with dark spots	3
2. Forewings with transverse markings	<i>gallagenitella</i> , p. 819
Forewings without such	<i>syloicolella</i> , p. 818
3. Ground color whitish gray	<i>attributella</i> , p. 817
Ground color yellowish	4
4. Apical part of forewings light	<i>bicostomaculella</i> , p. 817
Apical part of forewings dark	<i>saundersella</i> , p. 819

EPITHECTIS ATTRIBUTELLA Walker.

Gelechia attributella WALKER, Cat. Lep. Brit. Mus., XXIX, 1864, p. 593.—WALSINGHAM, Trans. Amer. Ent. Soc., Phila., X, 1882, p. 182.—RILEY, Smith's List Lep. Bor. Am., No. 5315, 1891.

Evagora difficilisella CHAMBERS, Can. Ent., IV, 1872, p. 65.

Gelechia difficilisella CHAMBERS, Can. Ent., IV, 1872, p. 192; V, 1873, pp. 187-188; Bull. U. S. Geol. Surv., IV, 1878, p. 142.

Taygete difficilisella CHAMBERS, Can. Ent., V, 1873, p. 231; VII, 1875, pp. 105, 106; Cinn. Quart. Journ. Sci., II, 1875, p. 289; Can. Ent., VIII, 1876, p. 19.

Epithecis attributella BUSCK, Dyar's List Amer. Lep., No. 5608, 1903.

Two of Chambers's types of *Gelechia difficilisella* (type no. 444) and specimens thus determined by Lord Walsingham are in the U. S. National Museum. They agree well with Chambers' description and were found identical with Chambers' types in the museum in Cambridge.

Lord Walsingham established the synonymy with Walker's species.

It is a very common species, collected by the writer in numbers on trunks of trees in Washington, District of Columbia.

Other specimens in the U. S. National Museum bear the following locality labels: Virginia, Maryland, Pennsylvania, and New York; the types came from Kentucky.

EPITHECTIS BICOSTOMACULELLA Chambers.

Gelechia bicostomaculella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 127; IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5322, 1891.

Epithecis bicostomaculella BUSCK, Dyar's List Amer. Lep., No. 5609, 1903.

Not *Gelechia bicostomaculella* DIETZ, Smith's List Ins. N. Jersey, 1900, p. 474; BUSCK, Dyar's List Amer. Lep., No. 5755, 1903.

Chambers had named another species *Depressaria bicostomaculella*¹ before describing this species, but changed that name later to *quercifoliella*,² when he discovered its food plant. This change was, of course, inadmissible, and the name *bicostomaculella* must be retained for that species, which is a true *Gelechia*, common in the Eastern States (p. 879). This, however, need not now interfere with the name of the present Colorado species, when it is transferred to *Epitheatis*, to which genus it was found to belong on examination of the type in the Museum of Comparative Zoology in Cambridge.

It is a very distinctly recognized species, of which, besides the type, I have seen only few specimens in Dr. Dietz's collection from Colorado like the type, and in U. S. National Museum from Arizona, collected by Messrs. E. A. Schwarz and H. S. Barber.

EPITHECTIS SYLVICOLELLA, new species.

Epitheatis sylvicolella BUSCK, Dyar's List Amer. Lep., No. 5610, 1903.

Antennæ dark fuscous, very indistinctly lighter annulated.

Labial palpi dark brown, second joint with apex and a narrow annulation below apex white; terminal joint with tip and two annulations white.

Face and head whitish, flecked with light brown.

Forewings, ground color white, thickly overlaid with dark fuscous. Three costal spots dark brown, nearly black, one at base, one just before the costal cilia, and one midway between these.

At the beginning of costal cilia is a whitish spot less overlaid with fuscous than the rest of the wing, and opposite on the dorsal margin is a similar but smaller spot. At basal third of dorsal margin is a short, transverse, oblique dark streak reaching the fold, on which it widens out to a small dark spot, sometimes more prominent than the streak and edged exteriorly with a few white scales.

On the middle of the disk is a blackish oblong dot edged with white, and at the end of the disk is a similar rather more prominent dot. Between and immediately below these dots is an oblong, longitudinal, dark-brown streak. At base of cilia, around costal, apical, and dorsal edge, is a row of equidistant dark-brown spots. Cilia yellowish fuscous. Hindwing light gray, with bluish reflections. Cilia yellowish. Legs yellowish, tarsi annulated with black.

Alar expanse.—15 mm.

Type.—No. 6358, U.S.N.M.

Habitat.—New York.

The types of this species were found in Fitch's collection, now in

¹Can. Ent., IV, p. 127.

²Idem., IV, p. 202.

the National Museum, and were labeled in his handwriting *Anacampsis sylvicolella*; hence the name.

EPITHECTIS SUBSIMELLA Clemens.

Parasia? subsimella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 173; Stainton Ed. N. Am. Tin., 1872, p. 137.

Parasia subsimella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 160.—RILEY, Smith's List Lep. Bor. Am., No. 5588, 1891.

Epithectis subsimella BUSCK, Dyar's List Amer. Lep., No. 5611, 1903.

Clemens' type is lost, but his generic characterization of this species shows that it must belong to the present genus.

A specimen in the U. S. National Museum, labeled by Lord Walsingham *Gelechia consinusella* Chambers, and which has a striking external similarity to that species, *Aproaerema consinusella*, p. 844, but which on examination was found to be an *Epithectis*, I have with but slight hesitation determined as the present species, with the description of which it agrees in all particulars.

EPITHECTIS SAUNDERSELLA Chambers.

Gelechia saundersella CHAMBERS, Can. Ent., VIII, 1876, p. 173; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5476, 1891.

Epithectis saundersella BUSCK, Dyar's List Amer. Lep., No. 5612, 1903.

A specimen with Chambers' label on the pin is in the U. S. National Museum, which I have compared and found identical with Chambers' types in Cambridge Museum. It is a very small, conspicuously spotted species, easily recognized from the description. I have seen no other specimen, and I refer it with some hesitancy to the present genus, not being able to ascertain the venation with absolute certainty.

Habitat.—Kentucky.

EPITHECTIS GALLÆGENITELLA Clemens.

Gelechia gallægenitella CLEMENS, Proc. Ent. Soc. Phila., II, 1864, p. 420; Proc. Ent. Soc. Phila., III, 1865, p. 506; Stainton Ed. Tin. N. Am., 1872, pp. 242, 259.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5376, 1891.—DIETZ, Smith's Ins. N. Jersey, 1900, p. 474.

Gelechia geminella RILEY, Can. Ent., III, 1871, p. 195.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5379, 1891.

Epithectis gallægenitella BUSCK, Dyar's List Amer. Lep., No. 5613, 1903.
Not *geminella* Linnaeus.

The type of this species is lost, but I have no doubt it is the same species that Riley thought was the European *Stenolechia geminella* Linnaeus. Both were bred from Cynipid galls on oak, and Clemens' description exactly fits Riley's specimen now in U. S. National Museum. There are also other specimens, bred by Miss Murtfeldt and by the writer from the same kind of galls.

Habitat.—Illinois, Missouri, District of Columbia.

PARALECHIA, new genus.

Plate XXX, fig. 18.

Antennæ simple, rather thick, three-fourths as long as forewing. Labial palpi moderate, curved, ascending; second joint somewhat thickened beneath with rough scales; terminal joint shorter than second, pointed. Forewings elongate, ovate; apex bluntly pointed, dorsal edge slightly sinuate at vein 2; 12 veins, 7 and 8 stalked to costa, 6 separate; 3, 4, and 5 long approximate from end of cell, 2 distant shorter.

Hindwings narrower than forewings, elongate trapezoidal, termen slightly sinuate below apex; 8 veins, 6 and 7 parallel, 5 approximate to 4, 3 and 4 connate or short stalked.

Forewings with raised scales.

Only the following two species are at present known:

Forewings white and black	<i>cristifasciella</i> , p. 820
Forewings brown	<i>pinifoliella</i> , p. 820

PARALECHIA PINIFOLIELLA Chambers.

Gelechia pinifoliella CHAMBERS, Journ. Cinn. Soc. Nat. Hist., II, 1880, p. 181.—COMSTOCK, Rep. U. S. Ent. Comm., V, 1890, p. 793, fig. 269.—RILEY, Smith's List Lep. Bor. Am., No. 5448.

Aristotelia pinifoliella DIETZ, Smith's List Ins. N. Jersey, 1900, p. 475.

Paralechia pinifoliella BUSCK, Dyar's List. Amer. Lep., No. 5614, 1903.

Chambers type (No. 458) and a large bred series of this common moth are in the U. S. National Museum.

Habitat.—Atlantic States.

PARALECHIA CRISTIFASCIELLA Chambers.

Gelechia cristifasciella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 87, 142.—RILEY, Smith's List Lep. Bor. Am., No. 5347, 1891.

Gelechia (Pecilia) inscripta WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 180.

Gelechia inscripta RILEY, Smith's List Lep. Bor. Am., No. 5390, 1891.—DIETZ, Smith's List Ins. N. Jersey, 1900, p. 474.

Paralechia cristifasciella BUSCK, Dyar's List Amer. Lep., No. 5615, 1903.

In the Museum of Comparative Zoology in Cambridge there are two types of *cristifasciella*, received from Chambers and in good condition. They show conclusively that this species is the same as Walsingham's *inscripta*, an authentic specimen of which, labeled by the author, is in the U. S. National Museum. The descriptions also agree.

I have repeatedly bred this species from oak, where the larva and pupa are found between leaves spun together, but have unfortunately no serviceable description of the larva.

The moth from overwintered pupæ appears in April, and in July another generation is found as imago.

Habitat.—Eastern United States, Missouri, Kentucky.

PHTHORIMÆA Meyrick.

Plate XXX, fig. 19.

Phthorimæa MEYRICK, Entom. Mo. Mag., XXXVIII, 1902, p. 103.

Dr. Edward Meyrick has been so kind as to publish this well-founded genus, which has *Gelechia operculella* Zeller as type, in advance of his paper, so that it could be included in this revision.

It has the following characters: Labial palpi long, curved; second joint with heavy divided brush beneath; terminal joint nearly as long as second, somewhat thickened, with appressed scales, especially at base; apex pointed.

Forewings elongate ovate pointed; 12 veins, 7 and 8 stalked to costa, rest separate; hindwings as broad as forewings, apex pointed, termen sinuate below apex; 8 veins; 6 and 7 separate parallel, 5 nearest 4, 3 and 4 connate. In the males the basal half of costal edge forms a broad, shallow fold in which a large, expansible bunch of long, scale-like hairs find place when the insect is at rest.

The recognized American species may be separated thus:

With longitudinal black streaks on forewings	<i>striatella</i> , p. 822
Without such streaks	1
1. With dark marking on outer half of costal edge.....	<i>marmorella</i> , p. 823
Without such markings	2
2. With distinct longitudinal ochreous streaks.....	<i>operculella</i> , p. 821
Without such streak s.....	<i>glochivella</i> , p. 822

PHTHORIMÆA OPERCULELLA Zeller.

Gelechia terrella WALKER (not FISCHER v. RÖSTERSTAMM), Cat. Lep. Ins. Brit. Mus., XXX, 1864, p. 1024.

Gelechia (? *Bryotropha*) *operculella* ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 262.

Gelechia operculella, CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5434, 1891.—HOWARD, U. S. Dept. Agr., Farmers' Bull., No. 120, 1900, p. 23.

Bryotropha solanella BOISDUVAL, Journ. Soc. Cent. Hort. de France, 1874, VIII, p. 713.

Gelechia tabacella RAGONOT, Bull. Soc. Ent. France, 1879.

Gelechia solanella STAUDINGER and REBEL, Cat. Lep. Eup., II, No. 2636, 1901.

Phthorimæa operculella MEYRICK, Ent. Mo. Mag., XXXVIII, 1902, p. 103.—BUSCK, Dyar's List Amer. Lep., No. 5616, 1903.

While studying Zeller's types in the Museum of Comparative Zoology in Cambridge, during May, 1900, I decided that his *Gelechia operculella* was the same as the common tobacco and potato feeding Tineid, which had hitherto passed under the name *solanella* Boisduval. Zeller's types in Cambridge, which are in fine condition, leave no doubt thereon, and his description and figure further substantiate it.

However, I did not at the time wish to change the name of so well-known an insect entirely on my own observation, but was able, through the kindness of Mr. S. Henshaw, to submit one type (male) to Mr. E.

Meyrick, who, by return mail, pronounced it to be *solanella* Boisduval, which name must fall for the earlier one of Zeller.

Zeller described two females, which he associated with this species with some doubt; it seems evident from his remarks that these two female "types" are really another species, as Zeller himself surmised. They are, with one male, in the collection of Lord Walsingham.

The species, which likely has its original home in America, is now introduced in Europe, Africa, and Australia, and is of some economic importance, owing to the damage to tobacco and potato crops accomplished by it.

The different life modes on the two food plants, as leaf miner on tobacco and as borer in the potato, are equally well known and have been the subject of a large amount of literature in economic entomology, references to which are not attempted here. Among the most important are those of Dr. L. O. Howard.¹

In the U. S. National Museum are bred specimens compared by the writer with Zeller's types and many specimens determined by Lord Walsingham as *Gelechia solanella* Boisduval, besides a very large series bred from tobacco and potato in the insectary of U. S. Department of Agriculture.

PHTHORIMÆA GLOCHINELLA Zeller.

Gelechia glochinella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 263, pl. III, fig. 18.—CHAMBERS, Bull. U. S. Geol. Surv., III, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am.

Gelechia solaniella CHAMBERS, Can. Ent., V, 1873, p. 176; Cinn. Quart. Journ. Sci., II, 1875, p. 239.

Gelechia cinerella MURTFELDT, Can. Ent., XIII, 1881, p. 244.

Gelechia inconspicuellla MURTFELDT, Can. Ent., XV, 1883, p. 139.

Gelechia piscipellis RILEY (not ZELLER), Smith's List Lep. Bor. Am., No. 5450, 1891.

Phthorimæa glochinella BUSCK, Dyar's List Amer. Lep., No. 5617, 1903.

This is the smaller and plainer species bred by Miss Murtfeldt from *Solanum* and mixed up by Chambers with his *similiella* (p. 779). In the U. S. National Museum is a specimen named by Lord Walsingham *Gelechia glochinella*; also a large bred series received from Miss Murtfeldt.

The male genitalia as figured by Zeller is the surest distinguishing character from the preceding very similar species.

PHTHORIMÆA STRIATELLA Murtfeldt.

Eucatoptus striatella MURTFELDT, Can. Ent., XXXII, 1900, p. 163.

Phthorimæa striatella BUSCK, Dyar's List Amer. Lep., No. 5618, 1902.

Lord Walsingham determined this insect generically for Miss Murtfeldt and placed it in his West Indian genus *Eucatoptus*, but even if

¹ Insect Life, IV, p. 239, and Report United States Department of Agriculture, 1898, p. 137.

that genus would hold (p. 794) the present species could not be included, as it differs from Walsingham's characterization both in palpi and wing structure.

Types, received from Miss Murtfeldt (Missouri), are in U. S. National Museum, where there is also a large series bred from *Solanum* by Mr. D. W. Coquillett in Los Angeles, California.

PHTHORIMÆA MARMORELLA Chambers.

Gelechia marmorella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 239; Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 54061, 1891.

Phthorimæa marmorella BUSCK, Dyar's List Amer. Lep., No. 5619, 1903.

Two types of this species in poor condition are in the Museum of Comparative Zoology. They show it to be a species of *Phthorimæa* different from any other recognized species. I have not met with other specimens.

Habitat.—Kentucky.

GNORIMOSCHEMA Busck.

Plate XXX, fig. 20.

Gnorimoschema BUSCK, Proc. U. S. Nat. Mus., XXIII, 1900, p. 227.

Antennæ simple; labial palpi long curved, second joint large, with a well-developed, furrowed brush beneath; terminal joint shorter than second, more or less thickened with scales except at extreme tip, which is pointed and thin, laterally compressed,¹ front sharp, sometimes slightly serrate. Maxillary palpi obsolete. Tongue moderate scaled at base.

Anterior wings narrow, elongate, somewhat sinuate below apex, which is bent slightly downward.

Posterior wings a little broader than anterior wings; costa deflected downward from the middle of the wing; apex produced, termen sinuate, tornus rounded, dorsal edge straight.

Venation.—Forewings: 12 veins, 7 and 8 stalked, the rest separate. Hindwings: 8 veins, 3 and 4 connate, 5 approximate to 4, 6 and 7 parallel.

The species recognized as belonging to this genus may be separated by the following table:

With dorsal edge distinctively darker than costal edge.....	1
Dorsal edge not darker than costal edge	3
1. Head and palpi, pure white	<i>terraccottella</i> , p. 835
Head and palpi, not pure white.....	2
2. Dorsal edge, blackish	<i>serratipalpella</i> , p. 829
Dorsal edge, not blackish.....	<i>florella</i> , p. 832

¹This is a better description than the original, given of third joint of the labial palpi; it is not scales, but the joint itself, which projects above the thickened part.

3. Dorsal edge, distinctly lighter than costal edge	4
Dorsal edge, not lighter than costal edge	10
4. Head unmottled brown	<i>baccharisella</i> , p. 825
Head not unicolorous brown	5
5. Head and palpi, whitish	6
Head and palpi, dark mottled	9
6. Ground color of forewing, light ochreous	<i>pallidochrella</i> , p. 828
Ground color, not ochreous	7
7. Forewings with dark streak on fold	<i>galleasteriella</i> , p. 825
Forewings without such streak	8
8. Costal half of forewings, nearly unicolorous	<i>albimarginella</i> , p. 827
Costal half of forewings, not unicolorous	<i>semicyclionella</i> , p. 828
9. Base of forewings, clear yellowish brown	<i>coquilletella</i> , p. 826
Base of forewing, not yellowish brown	<i>gallesolidaginis</i> , p. 824
10. Forewings with large scale tufts on dorsal half	<i>audiella</i> , p. 828
Forewings without scale tufts	11
11. Forewings with ocellate spots	12
Forewings without ocellate spots	14
12. Forewings with transverse fascia near base	<i>octomaculella</i> , p. 830
Forewings without such fascia	13
13. Forewings with longitudinal ochreous streaks	<i>ochreostrigella</i> , p. 831
Forewings without such streaks	<i>triocelella</i> , p. 830
14. Forewings with two oblique black lines crossing at basal third	<i>lavernella</i> , p. 833
Forewings without such lines	15
15. Forewing with longitudinal streaks	16
Forewing without longitudinal streaks	17
16. Streaks light yellow; two large black spots on disk	<i>collinusella</i> , p. 831
Streaks red; no large discal spots	<i>saphirinella</i> , p. 832
17. Ground color, whitish	18
Ground color, not whitish	19
18. Forewings uniformly dotted with dark scales	<i>tetradymiaella</i> , p. 834
Forewings not uniformly dotted with dark scales	<i>batanella</i> , p. 833
19. Forewings nearly unicolorous	20
Forewing strongly mottled	<i>banksiella</i> , p. 832
20. Forewings, brown	<i>pedmontella</i> , p. 829
Forewings, fuscous	<i>scutellariella</i> , p. 834

GNORIMOSCHEMA GALLÆSOLIDAGINIS Riley.

Gelechia gallasolidaginis RILEY, Mo. Rep. Nat. Inst., I, 1869, p. 173; II, 1870, pp. 20, 132, 134; Smith's List Lep. Bor. Am., No. 5377, 1891.—CHAMBERS, Can. Ent., VIII, 1876, p. 19; IX, 1877, p. 14; Cinn. Quart. Journ. Sci., II, 1875, p. 289; Bull. U. S. Geol. Surv., III, 1877, pp. 1, 28, 141; IV, 1878, pp. 115, 143.—KELlicOTT, Can. Ent., X, 1878, p. 201.—DIERZ, Smith's List Inst. N. Jersey, 1900, p. 474.

Gnorimoschema gallasolidaginis BUSCK, Proc. U. S. Nat. Mus., XXIII, 1900, p. 227; Dyar's List Amer. Lep., No. 5620, 1903.

Riley's type is still in perfect condition in the U. S. National Museum under type no. 452.

The species is recorded from Missouri (Riley), Colorado (Chambers), Michigan and New York (Kelliecott), New Jersey (Beutenmüller), and has been reared repeatedly in large series by the writer in the District of Columbia and surrounding country.

Larva in stem-galls on *Solidago*. Imagos issue during autumn (September) and also overwinter.

GNORIMOSCHEMA GALLCEASTERIELLA Kellicott.

Gelechia gallceasteriella KELLICOTT, Can. Ent., X, 1878, p. 203.—RILEY, Smith's List Lep. Bor. Am., No. 5378, 1891.

Gelechia galladiplopappi FYLES, Can. Ent., XXII, 1890, p. 248.—RILEY, Smith's List Lep. Bor. Am., No. 5375, 1891.

Gnorimoschema gallceasteriella BUSCK, Dyar's List Amer. Lep. No. 5621, 1903.

An authentic bred specimen received from Mr. Kellicott is in the U. S. National Museum. Authentic bred specimens of *galladiplopappi* were kindly sent me by Rev. Dr. Fyles; they show this species to be the same as Kellicott's, as descriptions and food plant would indicate. It is like the foregoing, a large, somewhat variable, but easily recognized species, which is about as common around Washington as *gallsolidaginis*.

Habitat.—Michigan (Kellicott), Canada (Fyles), District of Columbia (Busck).

Larva feeds during summer in stem-gall on various species of *Aster*. Imagos issue during autumn and also overwinter.

GNORIMOSCHEMA BACCHARISELLA, new species.

Gnorimoschema baccharisella BUSCK, Dyar's List Amer. Lep., No. 5622, 1903.

Antennæ reddish brown, each joint with tip and two small dots on the middle above black. Labial palpi of pronounced *Gnorimoschemat* form, reddish white with black shading on the outside of the second joint and at base and near tip of the terminal joint; extreme tip whitish.

Face, head, and thorax light clay brown, unmottled; basal one-sixth of forewings concolorous with thorax, with a small dark brown dot below costa at extreme base. In some specimens this yellow-brown color is continued, gradually fainter, along dorsal edge below fold. The rest of the wing is ochreous, thickly overlaid with dark fuscous scales, most numerous on the costal middle part of the wing and gradually becoming fewer toward apex, where the dark scales form narrow ill-defined longitudinal streaks on the yellow ground color. In the middle of the disk is a short oblong dark reddish-brown spot with black center, and at the end of the cell is a similar nearly moon-shaped spot.

Below the former on the fold are in some specimens a similarly colored reddish longitudinal spot.

There is some variation in the intensity of these spots and dark markings, some specimens appearing to the naked eye light reddish yellow with dark irregular longitudinal lines, while others appear dark

fuscous with narrow light streaks; around apical edge are a few blackish dots.

Hindwings shining silvery, cilia yellowish.

Abdomen robust, reddish yellow; females with stout straight protruding transparent ovipositor. Legs rather short, reddish white, shaded on the outside in irregular patches with black; tarsi blackish, with extreme tip of each joint white.

Alar expanse.—11–20 mm., the average size being 16 to 17 mm.

Habitat.—California.

Food plant.—*Baccharis pilularis*.

Type.—No. 6359, U.S.N.M.

Described from many specimens in perfect condition, bred and mounted by Mr. Koebele.

From Mr. Koebele's notes in the U. S. Department of Agriculture it is learned that he found the larvæ abundantly near San Francisco and in Berkeley County, California, in June on *Baccharis pilularis*. The larva makes a gall on the stem, and, according to Koebele, "they leave the galls when mature in the latter part of July and pupate in a case of silk in the sand."

It is not indicated in the notes whether this was under natural conditions or in his breeding cage. The moths issued September 15 to 26.

GNORIMOSCHEMA COQUILLETTELLA Busck.

Gnorimoschema coquilletella Busck, Proc. U. S. Nat. Mus., XXV, 1902, p. 405; Dyar's List Amer. Lep., No. 5623, 1903.

Antennæ dark brown, with narrow silvery white annulations. Labial palpy of typical form; second joint whitish, sprinkled with brown scales and with a black bar on the outside; terminal joint black with a white annulation round the middle.

Face whitish; head and thorax whitish, heavily overlaid with dark brown.

Basal fifth of forewing light yellowish brown, which color is continued in a downward-curved streak along basal half of dorsal edge and sharply limited toward the rest of the wing. The ground color in the rest of the wing is pale bluish white, each scale tipped with black.

Adjoining the basal fawn-colored part is a costal semicircular region, heavily overlaid with dark fuscous, and outside this is another similar dark costal spot, not so well defined. In the first of these dark semicircles on the middle of the cell is a dark reddish brown dot surrounded with a few fawn-colored scales, and below the second costal semicircle at the end of the cell is another similarly edged spot. A few dark fuscous scales are sprinkled irregularly over the apical part of wing and the extreme apex is dark fuscous. Hindwing silvery fuscous,

darker along costa and toward the tip; cilia yellowish. Abdomen dark shining fuscous; legs whitish, shaded with dark fuscous.

Alar expanse.—11.5 to 14 mm.

Habitat.—California.

Food plant.—*Applopappus pinifolius*.

Type.—No. 6288, U.S.N.M.

Described from many specimens bred by Mr. Koebele and Mr. Coquillett.

This species resembles in general appearance the foregoing *baccharisella* Busck, but it is a smaller and neater colored insect, and easily distinguished by the mottled head and the clearer, lighter basal area.

Both are nearly related to the type of the genus.

I take pleasure in naming this species after Mr. D. W. Coquillett, who has generously given me his notes on this and a few other Californian Gelechiidae.

Mr. Koebele's note on this insect is as follows:

Collected on *Biglora?* in the beginning of March, at Los Angeles, California, quite a number of larvæ, which spin the young leaves in the top together, so that it resembles a gall; in this they live, boring down into the stem half an inch to an inch, resembling in habits the *Pedisea* in tips of *Solidago*.

The larvæ, when full grown, left their tips and spun a cocoon on top of the ground; also on the side of the glass and on leaves.

Mr. Coquillett has kindly given me the following description of the larva from his notes:

Head yellowish brown, marked on each side with two blackish dots, of which the posterior one is nearly hidden by the first segment of the body; body dull pinkish white, sometimes tinged with brown on dorsum of abdomen; cervical shield pale yellowish; piliferous spots light colored; spiracles and anal plate concolorous with body; length, 10 mm.

Lives in a thin-walled oblong gall about 12 mm. long, formed of the undeveloped terminal bud on *Aplopappus pinifolius*. Several galls, each containing a single larva, were found March 7, 1886, near Los Angeles, California; one of these larvæ pupated April 16 and the moth issued May 18. During the following year a gall containing a larva was found in the same locality, April 9, and the moth issued June 12.

GNORIMOSCHEMA ALBIMARGINELLA Chambers.

Gelechia albimarginella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 291.

Gelechia albomarginella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 141.—

RILEY, Smith's List Lep. Bor. Am., No. 5305, 1891.

Gnorimoschema albimarginella BUSCK, Dyar's List Amer. Lep., No. 5624, 1903.

The unique type, labeled by Chambers in the Museum of Comparative Zoology, Cambridge, which, though not spread, is in fairly good condition, agrees with his description, and shows that the species belongs in this genus.

No other specimen is at present known to me.

Habitat.—Colorado.

GNORIMOSCHEMA SEMICYCLIONELLA, new species.

Gnorimoschema semicyclionella Busck, Dyar's List. Amer. Lep., No. 5625, 1903.

Antennæ white, sharply annulated with dark chocolate brown. Labial palpi whitish, suffused with brown except tip and annular around middle of terminal joint, which are clear white. Face and head white, lightly sprinkled with brown scales; thorax darker, more liberally sprinkled with brown. Forewings white with a faint reddish tint, thickly sprinkled with minute bluish black atoms, each scale being tipped with black. Near base of wing is a clear, light chocolate brown patch; before middle of wing is a large chocolate brown semicircular costal spot, reaching down over the fold and edged with lighter brown and white below and with pure white toward the brown basal area. Following and adjoining this costal spot is another smaller and less well-defined semicircular brown costal spot, and toward the tip in the middle of the wing is an obscure brown patch. Cilia brownish white. Hindwing light silvery gray, darker along costa and toward the tip; cilia yellowish. Abdomen dark chocolate brown, the two first joints above velvety yellowish, and tip of male anal tuft white. Legs whitish, sprinkled and shaded with dark brown; tarsi blackish, each joint tipped with white.

Alar expanse.—12 to 14 mm.

Habitat.—Colorado, New Mexico.

Type.—No. 6360, U.S.N.M.

I am indebted to Dr. Dietz for one of the specimens from which I have described this species; another was collected by Mr. H. S. Barber at Las Vegas, New Mexico.

GNORIMOSCHEMA PALLIDOCHELLEA Chambers.

Depressaria pallidochrella CHAMBERS, Can. Ent., IV, 1872, pp. 126, 129, 147, 148; Bull. U. S. Geol. Surv., III, 1878, p. 138.—RILEY, Smith's List Lep. Bor. Am., No. 5272, 1891.

Gelechia pallidochrella CHAMBERS, Bull. U. S. Geol. Surv., 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5439, 1891.

Gnorimoschema pallidochrella BUSCK, Proc. U. S. Nat. Mus., XXIV, 1902, p. 732; Journ. N. Y. Ent. Soc., X, 1902, p. 90 note; Dyar's List Amer. Lep., No. 5626, 1903.

The unique type of this species is found in the museum in Cambridge. It is in poor condition, but shows plainly that it belongs in the present genus. I have met with no other specimen.

Habitat.—Kentucky.

GNORIMOSCHEMA DUDIELLA, new species.

Gnorimoschema dudiella Busck, Dyar's List Amer. Lep., No. 5627, 1903.

Labial palpi of pronounced *Gnorimoschema* form, white thickly sprinkled with black, under side of brush black. Antennæ whitish gray, annulated with black, basal joint black. Face silvery, head

and thorax bluish white, liberally sprinkled with black and dark fuscous scales. Forewings elongate slender, apex deflexed; ground color bluish white, but so thickly overlaid with black and fuscous as to appear dark, each scale being mottled with white and black or dark fuscous. On the basal and apical one-third the light color prevails so as to make these parts light pearl gray to the naked eye; the middle part of the wing appears without a lens blackish, but under a lens is disclosed the composite coloration. On the middle of the cell is a short deep black perpendicular dash slightly edged with brown scales; at the end of the cell is another similar larger oblique velvety black dash, also edged with light brown. Parallel with the dorsal edge and just within this is a row of three equidistant large tufts of erect scales. Hindwings dark fuscous, cilia a shade lighter. First two abdominal segments are light ochreous above, rest of abdomen light iridescent gray; legs light gray on the inside, black on the outside; tarsal joints slightly tipped with white.

Alar expanse.—15 to 17.2 mm.

Habitat.—Arizona.

Type.—No. 6361, U. S. N. M.

Described from two perfect females collected and spread by Mr. H. S. Barber in June and July, 1901.

GNORIMOSCHEMA SERRATIPALPELLA Chambers.

Gelechia serratipalpella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 123; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5479, 1891.

Gnorimoschema serratipalpella BUSCK, Dyar's List Amer. Lep., No. 5628, 1903.

Type of this easily recognized species is found in the Museum of Comparative Zoology, where I have examined it and compared it with an identical specimen from Las Vegas, New Mexico, belonging to the National Museum.

I have also examined and received identical specimens from Dr. Dietz, collected at Denver, Colorado, from where Chambers' type came.

This species represent the extreme development of the genus, having the distinguishing palpal characters accentuated, as described by Chambers.

GNORIMOSCHEMA PEDMONTELLA Chambers.

Gelechia pedmontella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 123; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5444, 1891.

Gnorimoschema pedmontella BUSCK, Dyar's List Amer. Lep., No. 5629, 1903.

Chambers' type in Cambridge examined and found identical with specimens in the U. S. National Museum from Denver, Colorado, received through Dr. Dietz. The type came from Colorado. I have seen no other specimen.

GNORIMOSCHEMA TRIOCELLELLA Chambers.

Gelechia triocecella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 127.

Gelechia triocecella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 87 and 147.—RILEY, Smith's List Lep. Bor. Am., No. 5501, 1891.—DIETZ, Smith's List Ins. New Jersey, 1900, p. 474.?

Gnorimoschema triocecella BUSCK, Dyar's List Amer. Lep., No. 5630, 1903.

A well-preserved series of types with Chambers' written labels attached are found in the Museum of Comparative Zoology.

In the U. S. National Museum are several specimens, compared with and found identical with the types by the writer in 1900. One of these is named by Lord Walsingham; others were received from Dr. Dietz.

All are from Colorado, as also are Chambers' types.

Chambers recorded a variety from Kentucky, with which I am not acquainted.

Dr. Dietz recorded "a very close variety" from New Jersey, but I think it improbable that it really was this Western species.

It is a typical *Gnorimoschema*.

GNORIMOSCHEMA OCTOMACULELLA Chambers.

Gelechia octomaculella CHAMBERS, Conn. Quart. Journ. Sci., II, 1875, p. 291; Bull. U. S. Geol. Surv., III, 1877, p. 128; IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5432, 1891.

Gnorimoschema octomaculella BUSCK, Dyar's List Amer. Lep., No. 5631, 1903.

The unique type of this species is in the Museum of Comparative Zoology. It is in very poor condition, so poor that I did not at all recognize the very charming species it really is and described it in manuscript from a fine specimen in National Museum, bred by Mr. Koebele. However, on final examination last January I realized this. Chambers' meager description gives a very poor idea of the true appearance of a perfect specimen.

For this reason I append my description:

Antennae reddish white, each joint annulated with black. Labial palpi of typical *gnorimoschema* form, whitish, sprinkled with black atoms; terminal joint just before the tip nearly black. Face reddish white, head and thorax reddish white, sprinkled with small dark atoms. Forewings pale rosy white, each scale tipped with black; near base of wing a transverse dark rust brown fascia, narrowly edged on both sides with light yellowish brown. (This fascia is not mentioned by Chambers, though detectable in the type.)

On middle of cell are two large circular dark rust-brown spots, one above the other, edged with lighter brown. A somewhat smaller similar spot at the end of the cell. Toward apex a few scattered all black scales; extreme apical edge black; cilia dirty white. Hindwings light silvery gray, cilia yellowish. Abdomen dark silvery fuscous except third joint, which is velvety yellow above; underside silvery

white. Legs white, sprinkled with dark brown scales; tarsi dusky with end of each joint white.

Alar expanse.—12 mm.

Food plant.—*Acamptopappus sphaerocephalus*.

According to the notes of Mr. Koebele in the U. S. Department of Agriculture:

This species forms a gall-like swelling on tips of branches of the above plant. Larva were collected at Lancaster, California, in May; moth in June 26.

As can be seen from the above description, the name *octomaculella* is not appropriate and caused only by the poor condition of Chambers' type of this exquisite little insect.

GNORIMOSCHEMA HENSHAWIELLA Busck.

Gelechia ochreostrigella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 126.

Gnorimoschema ochreostrigella BUSCK, Dyar's List Amer. Lep., No. 5632, 1903.

Not *Gelechia ochreostrigella* CHAMBERS, Cinn. Quart. Journ. Sci., II, p. 247; Can. Ent., X, 1878, p. 50; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5431, 1891.

Chambers described two different insects as *Gelechia ochreostrigella*. The first one from California is a very distinct true *Gelechia*, as the type in Cambridge proves; this species will be found treated under its proper genus [p. 869].

The other species is the present, an entirely different smaller insect, three types of which were found in the Museum of Comparative Zoology, one of which, through the courtesy of Mr. S. Henshaw, was secured for the U. S. National Museum.

It is a typical easily recognized *Gnorimoschema*; I take pleasure in forming the new name required for this species in honor of my friend, Mr. Samuel Henshaw, of Cambridge.

The species bears a close resemblance to *Phthorimwa operculella* Zeller.

There is no references to this species in Chambers' Index.

No other specimens besides the three types are known to me.

Type.—No. 6362. U.S.N.M.

Habitat.—Colorado.

GNORIMOSCHEMA COLLINUSELLA Chambers.

Gelechia collinusella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 128; Bull.

U. S. Geol. Survey, IV, 1878, p. 142, 1878.—RILEY, Smith's List Lep. Bor. Am., No. 5339, 1891.

Gnorimoschema collinusella BUSCK, Dyar's List Am. Lep., No. 5633, 1903.

The unique type of this striking species, labeled by Chambers, is in Cambridge Museum. I have examined it carefully, and it belongs without doubt to this genus.

It is an easily recognized, large, light yellow species, but I have not met with other specimens.

Habitat.—Colorado.

GNORIMOSCHEMA SAPHIRINELLA Chambers.

Gelechia saphirinella CHAMBERS, Cinn. Quart. Journ. Sc., II, 1875, p. 250.

Gelechia sapharinella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5473, 1891.

Gnorimoschema saphirinella BUSCK, Dyar's List Am. Lep., No. 5634, 1903.

The two authentic types in the Museum of Comparative Zoology in Cambridge are in bad condition, but recognizable.

I have taken a few specimens of what I believe is this species at light in District of Columbia.

It was described from Colorado.

GNORIMOSCHEMA FLORELLA, new species.

Gnorimoschema florella, BUSCK, Dyar's List Amer. Lep., No. 5635, 1903.

Antennæ pale reddish with narrow deep black annulations. Labial palpi reddish white, darker and sprinkled with black on the underside; terminal joint brick red with tip black. Face and tongue ocherous white; head and thorax pale reddish. Costal half of forewings whitish yellow sprinkled with light ocherous brown scales; dorsal half of forewings brick red. At basal third is a small black costal spot; on middle of cell is small black dot, below and nearer base another similar dot on the fold, and at the end of the cell is a third; all of these are surrounded by a circle of whitish scales.

A few black scales are scattered irregularly on the wing, especially in the dorsal part and around the apical edge. Hindwings shining whitish fuscous, cilia reddish. Underside of body whitish; legs ocherous, barred with black; tarsal joints black, tipped with white.

Alar expanse.—17 mm.

Habitat.—Denver, Colorado.

Type.—No. 6363, U.S.N.M.

This striking species, very distinct from any other recognized species, was received from Dr. William Dietz.

GNORIMOSCHEMA BANKSIELLA, new species.

Gnorimoschema banksiella BUSCK, Dyar's List Amer. Lep., No. 5636, 1903.

Antennæ dark fuscous with narrow silvery annulations. Labial palpi dark fuscous, nearly black, upper side of second joint and tip of terminal joint whitish. Face light silvery gray; head and thorax dull dark fuscous nearly black; forewings concolorous with thorax with two round ocherous brown spots, one on middle of cell one at end of cell. Below on fold is a similarly colored diffused oblong spot touching the first discal spot and reaching down to the dorsal edge.

Apical part of wing more or less sprinkled with white scales. Hindwings light fuscous. The two first abdominal segments velvety yellow above, rest of abdomen blackish above, light silvery fuscous below; legs dark fuscous, each joint tipped with silvery white.

Alar expanse.—12 to 13 mm.

Habitat.—Northern Atlantic States.

Type.—No. 6364, U.S.N.M.

Described from several specimens collected by Mr. Nathan Banks, after whom I have pleasure in naming this species, at Sea Cliff, New York. In the National Museum are also specimens from Essex County, New York (Kearfott), and I have seen other specimens from Pennsylvania and Massachusetts. This is presumably the species identified by Dr. Dietz as a variety of *triocellula* Chambers, to which it comes quite near. It differs, however, in the lack of the ocellate spots, and is a much darker species than *triocellula*, which also has an angulated light fascia at apical third, lacking in *banksiella*.

GNORIMOSCHEMA BATANELLA, new species.

Gnorimoschema batanella Busck, Dyar's List Amer. Lep., No. 5637, 1903.

Antennæ silvery white, with sharp black annulations; labial palpi with second joint white, overlaid with dark fuscous, especially on the outside; terminal joint white, with base and ill-defined annulus before the tip dark fuscous; face whitish; head and thorax white, liberally sprinkled with light fuscous scales; forewings white, with a faint rosy tint, irregularly and sparsely sprinkled with black scales, especially toward the edges; a rather prominent group of them is found on costa at apical third. On the middle of the disk is a small light-brown spot; another similar is at the end of the cell. On the middle of the dorsal edge is a patch of brown, and between this and apex are two other small groups of brown scales. All of these brown markings are obscure, ill defined, and not constant in all specimens. The black scales form a nearly continuous thin line at base of cilia round the apical edge. Cilia white; hindwings dark, shining fuscous; cilia yellowish; abdomen dark fuscous above, silvery white below; legs white on the outside, sprinkled with fuscous; tarsi on the outside black, with each joint tipped with white, on the inside pure white; outer spurs black, inner spurs black on the outside, white on the inside.

Alar expanse.—11.5 to 12.5 mm.

Habitat.—New Jersey.

Type.—No. 6365, U.S.N.M.

Cotypes in the collection of Mr. William D. Kearfott, to whom the U. S. National Museum is indebted for the types.

GNORIMOSCHEMA LAVERNELLA Chambers.

Gelechia lavernella CHAMBERS, Can. Ent., VI, 1874, p. 242.—RILEY, Smith's List Lep. Bor. Am., No. 5400, 1891.

Gelechia physalivorella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1878, p. 238; Bull. U. S. Geol. Surv., IV, 1878, pp. 117 and 146.—RILEY, Smith's List Lep. Bor. Am., No. 5447, 1891.

Gnorimoschema lavernella Busck, Dyar's List Amer. Lep., No. 5638, 1903.

No authentic specimen of *lavernella* is found in any of the American collections, but in U. S. National Museum was a specimen which had Professor Riley's label, "*lavernella*," on the pin. This specimen was evidently received from and mounted by Chambers, and agrees with bred specimens of *physalivorella*, compared with the type in Cambridge, which also exhibit the peculiar dark crossing lines on forewing described by Chambers.

I believe the two names apply to the same species.

Larva feeds in the fruits of *Physalis*.

Habitat.—Texas, Missouri (Chambers), Michigan, District of Columbia.

GNORIMOSCHEMA SCUTELLARIÆELLA Chambers.

Celechio scutellariæella CHAMBERS, Can. Ent., V, 1873, p. 175; Bull. U. S. Geol. Surv., IV, 1878, pp. 116, 147.—RILEY, Smith's List Lep. Bor. Am., No. 5477, 1891.

Gnorimoschema scutellariæella BUSCK, Dyar's List Amer. Lep., No. 5639, 1903.

I have examined the unique type of this species in the Museum of Comparative Zoology in Cambridge. It is in poor condition, but I feel certain that it is a true *Gnorimoschema*, and the knowledge of the food plant should easily enable the recognition of this small, inconspicuous, nearly unicolorous, dark fuscous species.

Food plant.—*Scutellaria lateriflora*.

Habitat.—Kentucky.

I have not met with other specimens than the type.

GNORIMOSCHEMA TETRADYMIELLA, new species.

Gnorimoschema tetradymiella BUSCK, Dyar's List Amer. Lep., No. 5640, 1903.

Antennæ dark fuscous, toward the tip whitish. Labial palpi dirty white, second joint shaded with black on the outside, terminal with a black spot at base.

Face, head, and thorax whitish, sprinkled with light fuscous. Anterior wings whitish, evenly and thickly overlaid with gray and fuscous scales giving the appearance of "pepper and salt." Toward the apex the veins are slightly indicated by nearly unsprinkled whitish thin lines, with their interspaces rather more overlaid with dark scales than the rest of the wing. Cilia ashy gray. Hindwings nearly transparent, light gray with silvery reflections; cilia yellowish. Abdomen dark shining fuscous, the two first joints velvety, yellowish above. Legs white, slightly sprinkled with dark fuscous.

Alar expanse.—15.5 to 20 mm.

Habitat.—Los Angeles, California.

Food plant.—*Tetradymia canescens*.

Type.—No. 6366, U.S.N.M.

Described from specimens bred by Mr. Koehle, from whose notes

it is learned that the larvæ live in stem-galls on the above plant and that the imago issued September 18 to 23.

GNORIMOSCHEMA TERRACOTTELLA Busck.

Gnorimoschema terracottella Busck, Proc. U. S. Nat. Mus., XXIII, 1900, p. 227, pl. 1, fig. 3, Dyar's List Amer. Lep., No. 5641, 1903.—DYAR, Proc. Ent. Soc. Wash., IV, 1901, p. 471.

This striking species is easily distinguished from all others in the genus by its pure white head and costal markings.

Food plant.—*Ica imbricata*.

Habitat.—Palm Beach, Florida (Dyar).

Type.—No. 4934. U.S.N.M.

NEODACTYLOTA, new genus.

Plate XXX, figs. 21, 22, 23.

Type, *Dactylota snellenella* Walsingham.

As observed by Lord Walsingham,¹ his species described as *Dactylota snellenella* differs in several important characters from the type of *Dactylota* Snellen (*Didactylota* Walsingham.) I am now able to add a congeneric species, and it is proper to erect a separate genus for the American forms, which have the following characters: Labial palpi long, slender, recurved; second joint slightly thickened beneath with nearly smoothly appressed scales; terminal joint much longer than second, smooth, slender-pointed. Forewings narrow, elongate ovate, pointed; 12 veins, 7 and 8 stalked to costa, rest separate. Hindwings in male as broad as forewings, bilobed, costal and dorsal edge nearly parallel, apex produced, pointed, termen deeply emarginate below apex, forming a shorter obtuse second lobe; costal vein straight, connected by short oblique crossbar to the subcostal at basal third; veins 6 and 7 stalked; cell not closed; discal vein and veins 4 and 5 obsolete, the latter only slightly indicated by faint traces. The females are unknown to me, but, according to Lord Walsingham, they have not bilobed hindwings, though termen is deeply emarginate below the apex, and the discal vein is present, as well as veins 4 and 5, which are stalked. His lordship has kindly, through Mr. J. H. Durrant, sent me a sketch of the venation of the hindwing in the female, which is reproduced. (Plate XXX, fig. 22.)

The West Indian species, *Didactylota bicolor* Walsingham, will quite surely be found not to belong to this genus, but to *Nealyda* Dietz.

At present only the following two species are recognized, which may be easily separated, thus:

Forewings light gray.....	1, <i>snellenella</i> , p. 836
Forewings dark purplish brown.....	2, <i>barberella</i> , p. 836

¹Insect Life, 1, pp. 83, 84.

NEODACTYLOTA SNELLENELLA Walsingham.

Dactylota snellenella WALSINGHAM, Ins. Life, I, 1888, p. 83.—RILEY, Smith's List Lep. Bor. Am., No. 5210, 1891.

Didactylota snellenella WALSINGHAM, Proc. Zool. Soc. Lond., 1891, p. 522; 1897, p. 523.—BUSCK, Proc. U. S. Nat. Mus., XXIII, 1900, p. 228, pl. 1, fig. 4.

Neodactylota snellenella BUSCK, Dyar's List Amer. Lep., No. 5643, 1903.

One male cotype received from Lord Walsingham is in the National Museum, from which Plate XXX, fig. 21 is drawn.

In a letter of October, 1900, Lord Walsingham has kindly criticised my delineation of this species,¹ calling my attention to the faint traces of veins 4 and 5, which are still more noticeable in the following species [Plate XXX, fig. 23], and later he sent me the sketch of the female hindwing, which is reproduced in Plate XXX, fig. 22.

I have met with no other specimen of this species, which was described from Arizona.

NEODACTYLOTA BARBERELLA, new species.

Neodactylota barberella BUSCK, Dyar's List Amer. Lep., No. 5644, 1903.

Antennæ four-fifths as long as forewings, dark purple, nearly black, with a white longitudinal scale on each joint, forming an interrupted silvery white line from base to tip. Labial palpi long, slender, recurved; second joint thickened somewhat with smooth appressed scales, purplish black, mottled with silvery white scales; terminal joint long, thin, acutely pointed, black, sprinkled with sparse white scales. Tongue robust, covered with scant silvery scales.

Face, head, and thorax dark purplish brown. Forewings narrow, pointed; basal two-thirds dark purplish brown overlaid with evenly mixed black, red, and whitish scales. At apical third is a transverse, somewhat irregular and not very clearly defined narrow white fascia, outside of which the wing is lighter reddish brown, with strong purplish reflexions. Just outside the fascia on the costal edge is a small longitudinal shining salmon red dash; cilia dark purplish gray, with sparse black scales intermixed at base.

Hindwings as broad as forewings, bilobed, termen deeply excised beneath apex, which forms the upper long narrow-pointed lobe; the lower lobe is much shorter, broad, rounded, and blunt. Color, dark shining purplish gray; cilia lighter gray.

Abdomen, above, dark purplish brown; below, sprinkled with white scales.

Legs purplish, much sprinkled with white scales; tarsi purplish black, with each joint tipped with white.

Alar expanse.—14 mm.

Habitat.—Williams, Arizona.

¹Proc. U. S. Nat. Mus., XXIII, pl. 1, fig. 4.

Type.—No. 6367, U.S.N.M.

Collected May 27, 1901, by Mr. Herbert S. Barber, after whom this interesting and beautiful species is named.

DEOCLONA, new genus.

(Type, *Deoclona yuccasella* Busck.)

Antennae four-fifths as long as forewing simple; labial palpi with second joint long, curved, cylindrical thickened with even, smoothly appressed scales, abruptly cut off at apex; terminal joint very short, less than one-fourth of second, tapering pointed. Head and thorax smooth. Forewing elongate, fully four times as long as wide, costal and dorsal edges parallel, apex rounded blunt; 12 veins, 7 and 8 stalked to costa, rest separate; 1^b shortly furcate at base. Hindwings as broad as forewings, elongate trapezoidal, costa nearly straight, slightly depressed from basal third, termen straight; apex blunt; 7 veins, 5 absent, discal vein, except a remnant of the lower end, obsolete, 3 and 4 long stalked, 6 and 7 stalked. Males and females are alike. Only the following species is at present recognized.

DEOCLONA YUCCASELLA, new species.

Deoclona yuccasella Busck, Dyar's List Amer. Lep., No. 5645, 1903.

Antennae light yellow, with narrow brown annulations. Labial palpi light yellow. Face, head, and thorax light reddish yellow, a shade darker than the forewings, which are also unicolorous light reddish yellow, without any markings. In some specimens the forewings are slightly darker and more reddish toward apex than on basal half. Cilia yellowish white. Hindwings pale silvery yellow; cilia yellowish white. Abdomen yellow; legs pale yellow, without darker annulations; tarsi and tuft on posterior tibial whitish.

Alar expanse.—16.2 to 20 mm.

Habitat.—California.

Food plant.—*Yucca whipplei*.

Type.—No. 6368, U. S. N. M.

Described from six specimens bred by Mr. Koebele. The following is his note on the larva:

The larva lives in the dry seed pods, pupating in holes eaten therein, and moth issues therefrom in May. The seed pods were collected on the foothills, 16 miles east of Los Angeles, California.

PROSTOMEUS, new genus.

Type, *Prostomeus brunneus* Busck.

Plate XXXI, Fig. 25.

Antennae $\frac{3}{4}$, simple. Labial palpi long curved, strongly laterally compressed, sharp edged; second joint thickened above and below with appressed scales, abruptly cut off at apex, sharp edged in front;

terminal joint fully as long as second joint, strongly laterally compressed, sharp edged in front and behind, thickened with smoothly appressed scales, which terminate abruptly just before apex, leaving the acute tip projecting. Maxillary palpi obsolete. Tongue robust, spiraled, scaled at base. Forewings elongate, about four times longer than broad; costal and dorsal edge parallel; apex obtusely pointed; 12 veins, 7 and 9 stalked to costa, rest separate. Hindwings broader than forewings. Costa nearly straight, parallel with dorsal edge; apex obtuse, termen hardly sinuated, tornus and dorsal angle rounded; 8 veins, 6 and 7 stalked, 5 approximate to 4, 3 and 4 connate, 2 distant.

Allied to and resembling *Glyphidocera* Walsingham, but with simple antennae and 12 veins in forewing, and easily recognized by the peculiar blade-like labial palpi.

Besides the species here described there is in the U. S. National Museum a single specimen of another species belonging to this genus, but not sufficiently well preserved to describe.

PROSTOMEUS BRUNNEUS, new species.

Prostomeus brunneus Busck, Dyar's List Amer. Lep., No. 5646, 1903.

Antennae dark reddish brown, annulated with white. Labial palpi light brown, mottled with dark-brown and black scales; terminal joint with base, an annulus round the middle and apical third black. Head and thorax dark brown. Forewings light straw colored, overlaid with reddish brown; base dark purplish brown; along middle of costa from basal fourth to apical third a dark purplish brown oblong narrow patch. On the dorsal edge a larger similar patch, projecting up in the light middle part of the wing a boot-shaped figure, with the toe on the center of the cell, and the heel midway between this and a unicolorous circular spot at the end of the cell.

The region at tornus is dark brown, and the apical veins are slightly indicated by darker brown streaks. Around apex at base of the cilia is a row of dark, purplish-brown dots. Cilia brown.

Hindwings dark steel gray, lighter toward the base; cilia a shade lighter.

Abdomen dark purplish fuscous above; entire body light reddish yellow below. Legs light brown, annulated with black; tarsi black, with tip of each joint white.

There is some variation in the shade of the brown color in the different specimens, some being more reddish, others more yellowish, but the form of the markings seems constant.

Alar expanse.—15 to 15.5 mm.

Habitat.—Florida.

Type.—No. 6369, U.S.N.M.

Described from several specimens received from Wm. Beutenmüller.

POLYHYMNO Chambers.

Plate XXXI, fig. 26.

Polyhymno CHAMBERS, Can. Ent., VI, 1874, p. 246.

This genus, of which *Polyhymno luteostrigella* Chambers is the type, has the following characters: Labial palpi recurved, very long, slender, second joint slightly thickened with smoothly appressed scales, terminal joint as long or longer than second, pointed. Forewings narrow, elongate, caudate, the costal and dorsal edge both slightly excised before the tip, which is produced and hooked a little downward, 12 veins, 7 and 8 very long-stalked; or 11 veins, 7 and 8 coincident. Hindwings nearly as broad as forewings, elongate, apex produced, termen sinuate; 8 veins, 3 and 4 shortstalked, 5 approximate to 4, 6 and 7 longstalked; transverse vein nearly obsolete.

This characteristic genus has been recorded by Lord Walsingham from the West Indies and from Africa; in America it is a southern genus attached to leguminous food plants.

Only three species have been described from this continent; these may be separated as follows:

- Forewings with longitudinal spindle formed white streak, vein 8 present..... 1
- Forewings without such streak, vein 8 absent3. *seustrigella*, p. 840
- 1. Forewings with dorsal edge white.....*luteostrigella*, p. 839
- Forewings with dorsal edge dark*acaciella*, p. 839

POLYHYMNO LUTEOSTRIGELLA Chambers.

Polyhymno luteostrigella CHAMBERS, Can. Ent., VI, 1874, p. 247; Bull. U. S. Geol. Surv., IV, 1878, p. 161; Journ. Cinn. Soc. Nat. Hist., II, 1880, p. 203, fig. 26.—BEUTENMÜLLER, Abt. Ent., V, 1889, p. 37.—WALSINGHAM, Trans. Ent. Soc. Lond., 1891, pl. VII, fig. 78; Proc. Zool. Soc. Lond., 1897, p. 77.—RILEY, Smith's List Lep. Bor. Am., No. 5586, 1891.—BUSCK, Jour. N. Y. Ent. Soc., VIII, 1900, p. 236; Dyar's List Amer. Lep., No. 5647, 1903.
Polyhymno fuscostrigella CHAMBERS, Can. Ent., VIII, 1876, p. 30.

Of this easily recognized and elegant species the U. S. National Museum possesses two specimens labeled by Lord Walsingham and a good series bred by the writer in the District of Columbia. In localities where the food plant is found this species comes readily to light.

Food plant.—*Cassia chamaecrista*.

Habitat.—Texas, Florida, District of Columbia.

POLYHYMNO ACACIELLA Busck.

Polyhymno acaciella BUSCK, Jour. N. Y. Ent. Soc., VIII, 1900, p. 235, pl. IX, fig. 1; Dyar's List Amer. Lep., No. 5648, 1903.

This is a larger and darker species than the type of the genus, which it otherwise much resembles.

Food plant.—*Acacia farnesiana*.

Habitat.—Texas.

Type.—No. 5353, U.S.N.M.

POLYHYMNO SEXSTRIGELLA Chambers.

Polyhymno sexstrigella CHAMBERS, Can. Ent., VI, 1874, p. 248; Bull. U. S. Geol. Surv., IV, 1878, p. 161.—RILEY, Smith's List Lep. Bor. Am., No. 5587, 1891.—BUSCK, Journ. N. Y. Ent. Soc., VIII, 1900, p. 236; Dyar's List Amer. Lep., No. 5649, 1903.

One specimen in the U. S. National Museum named by Lord Walsingham I have compared and found identical with Chambers' type in the Museum of Comparative Zoology in Cambridge.

The venation of this species differs from that of the type of the genus only in the forewing, where vein 8 is absent, coincident with 7, which is very nearly the case in the other species also, where the stem of the fork of 7 and 8 is very long and the branches short.

The other differences in venation mentioned by Chambers are not borne out by the specimens, and the identical wing form and other characters place the species naturally in the same genus.

Habitat.—Texas.

APROÆREMA Durrant.

Plate XXXI, fig. 27.

Aproaerema DURRANT, Ent. Mo. Mag., XXXIII, 1897, p. 221.

Labial palpi very long, curved, second joint smooth, terminal joint longer than second, pointed. Forewings narrow, elongate pointed; 12 veins, 7 and 8 stalked, 6 sometimes out of 7 near base. Hindwings narrower than forewings, elongate trapezoidal, apex produced, pointed, terminally emarginate; 8 veins, 6 and 7 stalked, 3 and 4 connate, 5 approximate to 4.

Lord Walsingham pointed out¹ that the name *Anacampsis* hitherto had been applied erroneously to this genus instead of to the genus known as *Tachyptilia* Heinemann, containing the type of *Anacampsis*, *Tinea populella* Clerck, as specified by Curtis.² Mr. Durrant therefore proposed the name *Aproaerema* for the genus thus left nameless, the type of which is *anthyllidella* Hübner.

The genus is developed from *Anacampsis*, Curtis (*Tachyptilia* Heinemann), with a section of which it has great similarity in coloration, but it is easily distinguished by the sinuate hindwings.

All the species feed on leguminous plants.

I have recognized the following American species which may be separated by the table:

Forewings black or nearly so	1
Forewings lighter	4
1. Labial palpi with longitudinal white lines	2
Labial palpi without such lines	3

¹ Proc. Zool. Soc. Lond., 1897, p. 79.

² Br. Ent., 1827, Expl., pl. CLXXXIX.

- 2. Forewings sprinkled with bluish-white scales.....*crotolariella*, p. 841
- Forewings without such light scales.....*palpiliniella*, p. 841
- 3. With curved white fascia on middle of forewings.....*kearfottella*, p. 842
- Without such fascia.....*nigrella*, p. 842
- 4. Forewings ocherous white.....*nigratonella*, p. 843
- Forewings fuscous.....*concinusella*, p. 844

APROÆREMA CROTOLARIELLA Busck.

Approaerema crotolariella Busck, Proc. U. S. Nat. Mus., XXIII, 1900, p. 226, pl. 1, fig. 2; Dyar's List Amer. Lep., No. 5695, 1903.—DYAR, Proc. Ent. Soc. Washington, IV, p. 471, 1901.

This species is very near the following, *palpiliniella* Chambers, and has even the same coloration of the palpi as that species, but it is somewhat larger and may be readily recognized by the sprinkling of bluish-white scales on the forewings.

Food plant.—*Crotolaria pumila*.

Habitat.—Palm Beach, Florida.

Type.—No. 4933, U.S.N.M.

APROÆREMA PALPILINEELLA Chambers.

Gelechia palpilineella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 252; Bull. U. S. Geol. Surv., IV, 1878, pp. 88, 145.—RILEY, Smith's List Lep. Bor. Am., No. 5442, 1891.

Approaerema palpilineella Busck, Dyar's List Amer. Lep., No. 5696, 1903.

The supposed types (3) of this species in the Museum of Comparative Zoology in Cambridge are in poor condition, and represent at least two species in different genera, namely, the present and what I take to be *Aristotelia minimella* Chambers (p. 802). But the characteristic coloration of the labial palpi, mentioned by Chambers, which this species has in common with the preceding, shows that the name *palpiliniella* should be applied to the present species.

It has been bred in the insectary of the U. S. Department of Agriculture from red clover, on which it folds the leaves.

These bred specimens¹ were examined by Chambers in 1879, and in the Department notebook is Chambers' note on the specimens, in which he says:

Without specimens to compare it with I am unable to determine this species, but it is one of the group of small dark brown moths of the genus *Gelechia*, closely allied to *nigrella*, *palpiannulella*,² and *palpiliniella*, Chambers; possibly it may be one of these, if indeed these species are distinct, which may admit of doubt.³

I quote this note as one striking, but by no means unique, example of the difficulties which attend the determination of many of Chambers's species. With a practically valueless specific description, with absolutely no generic (sometimes not even family) characters given,

¹ Agr. Dept., No. 185.

² *Aristotelia absconditella* Walker, see p. 801.

³ Italicized by the writer.

and with most uncertain types mostly in miserable condition, representing two genera, the present worker can readily join in Chambers' own admission that there may indeed be doubt about the species.

The only way out of the difficulty is to select arbitrarily one species as Chambers' intended species, taking care that it does not disagree with his remarks, and that it is at least reasonable that it may represent his species.

Palpilincella is very commonly taken at light and is easily confounded with the equally common and similar *Aristotelia minimella* or with the following species. In U. S. National Museum are specimens from District of Columbia (Busck) and from New Jersey (Beutenmüller and Kearfott).

APROÆREMA NIGRELLA Chambers.

Gelechia nigrella CHAMBERS, Cinn. Quart. Journ. Sci., II, pp. 250, 252; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5417, 1891.

Aproærema nigrella BUSCK, Dyar's List Amer. Lep., No. 5697, 1903.

Of this species there is one "type" received from Chambers in the Museum of Comparative Zoology, but it is in miserable condition (only one pair of wings) and does not agree with Chambers' description, having a narrow but very distinct white fascia at apical third. However, there is undoubtedly some variation in this point in these species, and I see no good reason not to regard it as truly representing the species, which is a somewhat larger form than the foregoing and without the palpal ornamentation common to the two preceding species.

APROÆREMA KEARFOTTELLA, new species.

Aproærema kearfottella BUSCK, Dyar's List Amer. Lep., No. 5698, 1903.

Antennæ black with narrow silvery white annulations. Labial palpi silvery white, terminal joint darker toward the tip, sprinkled with fuscous. Eyes red as in the *agrimoniella* group of the genus *Anacampsis*. Face silvery white, head and thorax iridescent dark bluish slate colored. Forewings purplish black, a conspicuous narrow curved white fascia on the middle of the wing, with the centrum for the curve at the base of the wing; no other markings on the wing proper. Cilia purplish black, with the tips of the middle part on the dorsal edge silvery white. Underside dark fuscous, with the white fascia plainly seen. Hindwings dark purplish fuscous, nearly black, especially toward the tip. Abdomen above deep bluish black, below silvery fuscous. All legs silvery white except the femora, which are purplish black; tarsi dusky.

Alar expanse.—12.5 mm.

Habitat.—New Jersey.

Type.—No. 6370, U.S.N.M.

Cotype in collection of Mr. William D. Kearfott, to whom the National Museum is indebted for the type of this striking species.

It is in size and coloration nearest and very close to the *agrimoniella* group of the following genus, *Anacampsis*, and it is only referable to the present genus on account of the sinuate hindwings.

APROÆREMA NIGRATOMELLA Clemens.

Gelechia nigratomella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, pp. 11, 121; III, 1864, p. 507; Stainton Ed. N. Am. Tin., 1872, pp. 217, 224, 260.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5416, 1891.

Gelechia apicilinella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, p. 120; Stainton Ed. N. Am. Tin., 1872, pp. 223, 224.

Gelechia apicivella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5312, 1891.

Parasia apicistrigella CHAMBERS, Can. Ent., IV, 1872, p. 66.

Gelechia apicistrigella CHAMBERS, Can. Ent., IV, 1872, p. 175; Bull. U. S. Geol. Surv., IV, 1878, p. 141.

Anacampsis apicistrigella DIETZ, Smith's List Insects New Jersey, 1900, p. 475.

Aproærema nigratomella BUSCK, Dyar's List Amer. Lep., No. 5699, 1903.

One of the few of Clemens' types, which is still in existence in the Academy of Natural Sciences, is the type of the present species, which was found in good condition in May, 1900, during my visit there; it bears Clemens's No. 63 on the label, corresponding to a list in his handwriting with *nigratomella* var. for this specimen.

Clemens described two varieties of this species, one with shining white forewings, the other with ochreous white wings with costal edge at base pure white; there is some slight variation in the specimens I have seen, but all have at least an ochreous tint.

Chambers's type of *apicistrigella* in the Museum of Comparative Zoology in Cambridge is identical with Clemens' species, as the descriptions would indicate.

Riley made this latter a synonym of *Gelechia apicilinella* Clemens; the descriptions do not seem to support this synonymy and I doubt its correctness, but as Clemens' type is lost it must stand for the present on Riley's authority.

This species is very close to the following, *concinusella* Chambers, having the identical ornamentation, but easily distinguished by the light groundcolor, while *concinusella* has the groundcolor of the forewing dark. Chambers says in his description of *concinusella*:¹

It may prove to be identical with *Gelechia apicistrigella* Chambers, but I think not.

Lord Walsingham evidently was in doubt whether the two were merely varieties of the same species or distinct species, as is proved

¹U. S. Geological Survey Bull., III, p. 127.

by two specimens in the U. S. National Museum which are labeled in his handwriting, respectively, "*Concinusella Cham ? = apicistrigella, dark variety,*" and "*apicistrigella Cham ? = Concinusella, light variety,*" but inasmuch as there seems to be no gradual transition between the two different forms, they must be regarded as distinct species, as I feel certain they are, until disproven by the breeding of both forms from the same kind of larva.

I have examined very many specimens of this common form, among which specimens named by Lord Walsingham in Professor Fernald's collection and bearing his blue labels no. 115, 1094, 1116, and 1033 corresponding with the identification in his notebook as *apicistrigella*.

Habitat.—Eastern United States, Kentucky, Colorado.

APROÆREMA CONCINUSELLA Chambers.

Gelechia concinusella CHAMBERS, Cinn. Quart. Journ. Sc., II, 1875, p. 253; Bull. U. S. Geol. Surv., IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5340, 1891.

Gelechia concinuisella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 127.

Aproærema concinusella BUSCK, Dyar's List Amer. Lep., No. 5700, 1903.

Type No. 448, in the U. S. National Museum, received from Chambers, as this species agrees well with description and is identical with his types in the Cambridge Museum.

This species has a notable color resemblance to *Epithectis (Parasia ?) subsimella* Clemens.

Habitat.—Texas, Colorado.

ANACAMPSIS Curtis.

Plate XXXI, fig. 28.

Type, *Tinea*, i. e. *Tinea pojulella* Clerck.

Anacampsis CURTIS, Brit. Ent., 1827, expl. pl. CLXXXIX.

Tachyptilia HEINEMANN (Meyrick, Staudinger and Rebel), Schmetterlinge Deutschlands u. d. Schweiz, II, 1870, p. 321.

Labial palpi very long curved, second joint thickened with smoothly appressed scales, sometimes roughened above in the middle; terminal joint longer than second, slender pointed. Abdomen somewhat flattened. Forewings elongate, apex blunt, termen very oblique; 12 veins, 7 and 8 stalked, rest separate. Hindwings as broad or broader than forewings, trapezoidal termen not sinuate, 8 veins, 3 and 4 connate, 5 parallel, 6 and 7 connate.

I have recognized the following American species as belonging to this genus:

Basal half of forewings without any markings	1
Basal half of forewings more or less mottled	8
1. Forewings without white markings	2
Forewings with white markings	3
2. Color ochreous	<i>fullonella</i> , p. 849
Color black	<i>lupinella part</i> , p. 850

3. Forewings with transverse fascia	4
Forewings without transverse fascia	6
4. Forewings with three apical longitudinal white dashes	<i>tristriella</i> , p. 851
Forewings without such dashes	5
5. Color markedly darker outside the fascia	<i>agrimoniella</i> , p. 850
Color dark on both sides of the fascia	<i>lupinella</i> , part., p. 850
6. Forewings with one costal white streak	7
Forewings with two costal white streaks	<i>levipedella</i> , p. 851
7. Color light ochreous brown	<i>paltodoriella</i> , p. 848
Color black	<i>lupinella</i> , part., p. 850
8. With large semicircular dark dorsal spot	<i>cycella</i> , p. 848
Without such spot	9
9. With dark costal spot	<i>lagunculariella</i> , p. 848
Without such spot	10
10. With face whitish	<i>argyrothamniella</i> , p. 847
Face not white	11
11. With sharp white markings	<i>niveopulcella</i> , p. 847
Markings indistinct	12
12. Groundcolor ash-gray	<i>cresecentifasciella</i> , p. 846
Groundcolor brownish	13
13. Alar expanse more than 20 mm	<i>innocella</i> , p. 845
Alar expanse less than 20 mm	<i>rhoifruetella</i> , p. 845

ANACAMPSIS INNOCUELLA Zeller.

Gelechia (Tachyptilia) innocella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 249.

Gelechia innocella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5389, 1891.

Anacamptis innocella BUSCK, Dyar's List Amer. Lep., No. 5701, 1903.

This species and still more the following are, as Zeller remarked, very similar to the European *Anacamptis populella* Clerck, but both have the wings more blunt.

I have examined the types of the present species in Cambridge.

In the National Museum is a series, identical with the types, bred from leaves of cottonwood received from Wyoming; also a large series bred from cottonwood in Colorado by Dr. Dyar.

The larva rolls the leaves in the same fashion as does the European *populella*.

Zeller's types are from Texas.

ANACAMPSIS RHOIFRUCTELLA Clemens.

Gelechia rhoifruetella CLEMENS, Proc. Acad. Nat. Hist. Phila., 1860, p. 163; Proc. Ent. Soc. Phila., II, 1863, p. 121; Stainton Ed. N. Am. Tin., 1872, pp. 40, 114, 225.

Gelechia rhoifruetella CHAMBERS, Can. Ent., III, 1872, p. 68; Bull. U. S. Geol. Surv., IV, 1878, p. 146.—ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 252.—COQUILLET, Papilio, III, 1883, p. 99.—RILEY, Smith's List Lep. Bor. Am., No. 5466, 1891.

Tachyptilia rhoifruetella DIETZ, Smith's List Ins. N. Jersey, p. 474, 1900.

Gelechia (Tachyptilia) consonella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien., XXIII, 1873, p. 251.—WALSINGHAM, Trans. Amer. Ent. Soc. Phila., X, 1882, p. 183.

- Gelechia consonella* CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5338.
- Gelechia quadrimaculella* CHAMBERS, Can. Ent., VI, 1874, p. 237; Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5459, 1891.
- Gelechia ochreocostella*, CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 91, 145.
- Anacampsis rhoifrutella* BUSCK, Dyar's List Amer. Lep., No. 5702, 1903.
- Not *Gelechia quadrimaculella* CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 290; Bull. U. S. Geol. Surv., III, 1877, p. 128.

Lord Walsingham has established the synonymy *rhoifrutella*=*ochreocostella*, and suggested that *consonella* Zeller was also this species. I have seen the types in the Museum of Comparative Zoology of *quadrimaculella* Chambers, *consonella* Zeller, and *ochreocostella* Chambers, and in U. S. National Museum there is a type (No. 461) of *ochreocostella* and specimens named by Walsingham, *rhoifrutella*. All of these specimens are identical and confirm Lord Walsingham's synonymy, adding that of *quadrimaculella* Chambers, as was to be expected from the description of the species.

Both of Chambers' species as well as Zeller's type came from Texas. Clemens presumably reared his in Pennsylvania.

The other species named by Chambers *quadrimaculella* and afterwards renamed *pravinominella*, is evidently an entirely different insect, which I have recognized as a species of *Gelechia*, under which genus it is treated (p. 875).

ANACAMPSIS CRESCENTIFASCIELLA Chambers.

- Gelechia crescentifasciella* CHAMBERS, Can. Ent., VI, 1874, p. 237; Cinn. Quart. Journ. Sci., II, 1875, p. 255; Bull. U. S. Geol. Surv., IV, 1878, pp. 90, 142.
- Anacampsis crescentifasciella* BUSCK, Dyar's List Amer. Lep., No. 5703, 1903.
- Not *Gelechia crescentifasciella* WALSHINGHAM, Trans. Amer. Ent. Soc. Phila., X, 1882, p. 179.

Lord Walsingham made this species a synonym of *Gelechia conclusella* Walker, but this was clearly caused by a mistake. The supposed type of *crescentifasciella* from Mr. Goodell's collection, on the strength of which Walsingham made the synonymy, is now in Professor Fernald's collection, and he has explained that by mistake this specimen was represented as the type, but that it really was not authentic. It is a specimen of *conclusella* Walker. In Lord Walsingham's notebook¹ is written under the number corresponding to his blue label on this specimen "1034, *G. conclusella* Walker = *G. crescentifasciella*, Chambers's type," but the word "type" was afterwards crossed over.

In the U. S. National Museum there is a type (No. 446) received from Chambers with his handwriting *crescentifasciella*. This type is the

¹ See preface, p. 768.

same as eight specimens in Cambridge Museum, also received from Chambers, and furnished with his label. These specimen agree with Chambers' description, and undoubtedly represent the present species, which is very different from *conclusella* Walker. One of these specimens, originally from the Salem collection, bears Walsingham's blue label no. 980, and is labeled in his handwriting "*Gelechia crescentifasciella* Chambers, but quite distinct from his type."¹

Crescentifasciella does resemble, as remarked by Chambers, *Gelechia quadrimaculella*,² "but is smaller and of a more ashen hue."

No other specimen than the types mentioned are known to me.

The supposed "type" in Professor Fernald's collection, received from Chambers through Miss Murtfeldt, is an *Elachistid*, wrongly identified.

ANACAMPSIS NIVEOPULVELLA Chambers.

Gelechia niveopulvella CHAMBERS, Can. Ent., VII, 1875, p. 210; Bull. U. S. Geol. Surv., IV, p. 1878.—RILEY, Smith's List Lep. Bor. Am., No. 5419, 1891.

Anacamptis niveopulvella, BUSCK, Dyar's List Amer. Lep., No. 5704, 1903.

The unique type of this species was obtained in good condition from the Belanger collection, Laval University, Quebec, where it has been since returned by Chambers in 1875. It bears Chambers' label, agrees well with his description, and is undoubtedly authentic.

It proves the species to be a large *Anacamptis* of the size of *innocella* Zeller. It has the same general pattern of ornamentation as this species, but much more pronounced in black and white. In Europe are known very similar corresponding varieties of *Anacamptis populella* Clerck, and *niveopulvella* may ultimately prove to be such a variety of *innocella*; but as it is easily recognized and markedly different from the common form of *innocella*, and as no intermediate forms are known as yet, it must be retained as a good species until proof of the identity with *innocella* is given by breeding.

In the U. S. National Museum are other specimens identical with the type from Vancouver's Island, and the northern latitude may be cause of the variety. Chambers' type came from Canada.

ANACAMPSIS ARGYROTHAMNIELLA Busck.

Anacamptis argyrothamniella BUSCK, Proc. U. S. Nat. Mus., XXIII, 1900, p. 231; Dyar's List Amer. Lep., No. 5705, 1903.—DYAR, Proc. Ent. Soc. Washington, IV, 1901, p. 474.

Type.—No. 4938, U.S.N.M.

Food plant.—*Argyrothamnia blodgettii*.

Habitat.—Palm Beach, Florida.

¹The supposed type from Goodell's collection.

²*Anacamptis rhoifrutella* Clemens, p. 845.

ANACAMPSIS LAGUNCULARIELLA Busck.

Anacampsis lagunculariella Busck, Proc. U. S. Nat. Mus., XXIII, 1900, p. 230, pl. 1, fig. 6; Dyar's List Amer. Lep., No. 5706, 1903.—DYAR, Proc. Ent. Soc. Washington, IV, 1901, p. 474.

Type.—No. 4937, U.S.N.M.

Food plant.—*Laguncularia racemosa*.

Habitat.—Palm Beach, Florida.

ANACAMPSIS CYCLELLA, new species.

Anacampsis cyclella Busck, Dyar's List Amer. Lep., No. 5707, 1903.

Antennæ whitish yellow, annulated with black. Labial palpi whitish yellow, terminal joint toward tip fuscous. Face, head, and thorax whitish yellow. Ground color of forewings whitish yellow shaded with darker fawn. On the middle of the dorsal edge is a large, semi-circular, dark olive-brown spot, reaching to the middle of the wing and edged with white. The apical half of costal edge is of this same dark brown color, interrupted by four oblique white streaks, the first near the middle of the wing, the second at beginning of costal cilia, both directed outward. The two last streaks are smaller nearer apex and directed inward. The second costal streak is faintly continued in a thin, outwardly pointed, V-shaped fascia, at the tip of which is a longitudinal black dash, edged with white scales. Above and below this dash, outside of the faint white fascia, the wing is finely checkered with black and white scales. On the middle of the wing at the end of the cell is a small, dark brown, oblong spot. Upper half of the cilia is dark reddish brown, with base white; through this white base runs a heavy black line parallel with the edge of the wing. Lower half of cilia yellowish white. When the moth is at rest the two dorsal spots on the wings unite to form a conspicuous dark circle, edged with white. Hindwing dark olive brown, lighter and silvery toward the base; cilia golden. Abdomen and underside of thorax silvery yellow. Legs yellowish white annulated with brown; tarsi dark brown tipped with white. Alar expanse, 14 to 14.5 mm.

Habitat.—Arizona.

Type.—No. 6371, U.S.N.M.

Described from three well-preserved specimens—two collected by Mr. E. A. Schwarz, at Santa Rita Mountains, in May and June; the third collected by Mr. H. S. Barber, in July, at Williams, Arizona.

ANACAMPSIS PALTODORIELLA, new species.

Anacampsis paltodoriella Busck, Dyar's List Amer. Lep., No. 5708, 1903.

Antennæ silvery white with a heavy longitudinal dark brown line running from base to tip. Labial palpi, second joint yellowish white, terminal joint silvery white with a slender longitudinal black line in

front from base to apex. Face creamy white; head and thorax light drab colored. Forewings drab colored, lightest nearly white along the costa, gradually darker toward dorsal edge.

In the middle of the cell is a small indistinct blackish dot, a similar one nearer base on the fold and a third at the end of the cell. At apical fourth is an oblique narrow white streak directed outward and nearly meeting a similar but curved dorsal streak directed upward and outward. Both streaks are slightly edged with black anteriorly. The area between the dorsal streak and the edge of the wing is white, mottled finely with black, each scale being tipped with black. Apical cilia dark brown with base whitish and containing a heavy blackish perpendicular line; dorsal cilia yellowish white with the apical dark line continued fainter and interrupted along the edge of the wing. Hindwings dark purplish fuscous, cilia a shade lighter and with a narrow whitish line at base along the edge of the wing. Abdomen dark purplish except first two joints above which are light velvety yellow, anal tuft yellowish.

Fore and middle legs and underside of thorax deep dull brown, nearly black; tarsal joints tipped with yellow; hindlegs on the outside dark brown mottled with yellow, the inside and tuft on tibial yellow, tarsi banded with yellow.

Alar expanse.—3 mm.

Habitat.—Mesilla Park, New Mexico.

Type.—No. 6372, U.S.N.M.

A beautiful species, near the foregoing, *cyclella*, collected by Prof. T. D. A. Cockerell.

The wing pattern strongly reminds one of the *striatella* group of the genus *Paltodora*.

ANACAMPSIS FULLONELLA Zeller.

Gelechia (*Ceratophora*?) *fullonella* ZELLER, Verh. k. k. zool.-bot. gesell. Wien, XXIII, 1873, p. 276.

Gelechia fullonella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5366, 1891.

Gelechia rufusella CHAMBERS, Can. Ent., VI, 1874, p. 240; Bull. U. S. Geol. Surv., IV, 1878, p. 1474.—RILEY, Smith's List Lep. Bor. Am., No. 5472, 1891.

Gelechia (*Trichotaphe*) *refusella* WALSLINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 184.

Gelechia subrubrella CHAMBERS, Can. Ent., VI, 1874, p. 240; Cinn. Quart. Journ. Sci., II, 1875, p. 254; Bull. U. S. Geol. Surv., IV, p. 147, 1878.—RILEY, Smith's List Lep. Bor. Am., No. 5486, 1891.

Meusa rubescens WALSLINGHAM, Proc. Zool. Soc. Lond., p. 319, 1881, pl. xxxvi, fig. 9.

Anacamptis fullonella BUSCK, Dyar's List Amer. Lep., No. 5709, 1903.

The types of *fullonella* are in the possession of Lord Walsingham, to whom I am indebted for the information (in letter of May 10, 1901) that it is the same as Chambers' *rufusella*.

Of this latter species I have examined type no. 463 in the U. S. National Museum, and Chambers' types in Cambridge as well as specimens in the National Museum and in the Philadelphia Academy of Natural Sciences, determined by Lord Walsingham; they are all identical and undoubtedly represent Chambers' *rufusella*.

The supposed type of this species in Professor Fernald's collection is a very similar species of *Trichotaphe*, which I feel confident represents Chambers' *Gelechia bidiscomaculella* (p. 914).

In the U. S. National Museum are undoubted specimens of *rufusella* which, in my opinion, represent Chambers' *subrubrella*, which species Chambers himself, in his original description, suggested was only a variety of *rufusella*. As all authentic specimens of *subrubrella* are lost, and as *rufusella* is a somewhat variable species, I place the two as synonyms without much hesitation, thus disposing of an otherwise empty name.

Lord Walsingham suggested that this species is a *Trichotaphe*, but the separate veins 2 and 3 in forewings and the very long terminal joint of the labial palpi place it in the present genus.

The general habitus of the species is truly very similar to *Trichotaphe*, and it is one proof of the close relationship of the two genera.

All the specimens I have seen are from Texas.

ANACAMPSIS LUPINELLA Busck.

Anacamopsis lupinella Busck, Can. Ent., XXXIII, 1901, p. 14; Dyar's List Amer. Lep., No. 5710, 1903.

Type.—No. 5351. U. S. N. M.

Food plant.—*Lupinus perennis*.

Habitat.—Canada.

Since describing this species I have had the pleasure of breeding it myself from larva, kindly sent me by my friend, Mr. Arthur Gibson, Ottawa, Canada, thus obtaining more material of this interesting species.

ANACAMPSIS AGRIMONIELLA Clemens.

Gelechia agrimoniella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, pp. 162, 434; Proc. Ent. Soc. Phila., II, 1863, p. 120; Stainton Ed. Tin. N. Am., 1872, pp. 40, 112, 224.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5301, 1891.

Gelechia (Anacamopsis) agrimoniella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 275

Tachyptilia agrimoniella DIETZ, Smith's List Ins. N. Jersey, 1900, p. 474.

Gelechia aduncella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XVIII, 1868, p. 614.

Gelechia alerusella RILEY, Smith's List Lep. Bor. Am., No. 5299, 1891.

Anacamopsis agrimoniella Busck, Can. Ent., XXXIII, 1901, p. 15; Dyar's List Amer. Lep., No. 5711, 1903.

This well-known and thoroughly described species has been recorded from Pennsylvania, District of Columbia, and Georgia. In the

National Museum are also bred and collected specimens from Virginia, New York, and Kansas.

Food plant.—*Agrimonia*.

This and the following species have a marked resemblance to the *anthyllidella* group of the genus *Aprozema*, which has caused former workers (Zeller, Stainton, and Walsingham) to place it in that genus in spite of the differing wing form and venation, but they clearly belong to the present genus, and only indicate the relationship of the two genera.

ANACAMPSIS TRISTRIGELLA Walsingham.

Gelechia (*Anacampsis*) *tristrigella* WALSINGHAM, Trans. Amer. Ent. Soc. Phila., X, 1882, p. 181.—COQUILLET, Papilio, III, 1883, p. 91.

Gelechia tristrigella COMSTOCK, Rep. U. S. Ent. Comm., V, 1890, p. 639.—RILEY, Smith's List Lep. Bor. Am., No. 5502, 1891.

Anacampsis tristrigella BUSCK, Can. Ent., XXXIII, 1901, p. 15; Dyar's List Amer. Lep., No. 5712, 1903.

Of this easily recognized species I have identified a specimen from Kansas in U. S. National Museum, which identification I subsequently had opportunity to verify by comparison with the type in Professor Fernald's collection.

Food plant.—*Corylus americana* (Coquillett).

ANACAMPSIS LEVIPEDELLA Clemens.

Strobisia levipedella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, p. 4; Stainton Ed. Tin. N. Am., 1872, p. 207.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 162.—FREY, Stett. Ent. Zeit., XXXIX, 1878, p. 251.—RILEY, Smith's List Lep. Bor. Am., No. 5584, 1891.

Anacampsis levipedella BUSCK, Can. Ent., XXXIII, 1901, p. 15; Dyar's List Amer. Lep., No. 5713, 1903.

The type of this species is lost, but no doubt whatever exists about the identity of this common, striking, well-described species.

I have examined specimens determined by Chambers in the Museum of Comparative Zoology, in Cambridge, and specimens named by Lord Walsingham in the National Museum.

While this species has a certain general resemblance to the genus *Strobisia*, its structural characters place it in *Anacampsis*, in which it finds a near relative in the preceding species, *tristrigella* Walsingham.

Professor Frey's excellent description of the characteristic underside of the wings is an important addition, and emphasizes the relationship with this group.

The species is rather common around Washington City.

GELECHIA Hübner.

Plate XXXI, fig. 29.

Gelechia HÜBNER, Verz. bek. Schmett., 1816, p. 415.

Cirrho CHAMBERS, Can. Ent., IV, 1872, p. 146.

Oseus CHAMBERS, Conn. Quart. Journ. Sci., II, 1875, p. 255.

Pseudochelaria DIETZ, Ent. News, XI, 1900, p. 252, pl. 1, fig. 3.

Labial palpi long curved, second joint more or less thickened beneath, with rough scales, sometimes with large developed brush, sometimes furrowed; terminal joint nearly as long or longer than second joint, smooth pointed. Forewings elongate pointed, with 12 veins, 7 and 8 stalked, rest separate. Hindwings nearly as broad or broader than forewings; apex pointed, termen more or less sinuate; 8 veins, 3 and 4 connate or short stalked, 5 approximate to 4, 6 and 7 approximate, connate or stalked.

Two species, namely, *conclusella* Walker and *basquella* Chambers, which have been included in the present genus, differ from this synopsis in having veins 3 and 4 in the forewings stalked, but I do not believe generic separation would be justified on that ground, as there is a tendency in allied species to have these veins approximate, or even connate (*Gelechia abdominella* Busck), and as they in all other particulars agree with the genus.

Chambers' genus *Cirrho* does not in any way differ from *Gelechia*, as examination of the type has proven.

Oeseis Chambers has very strongly developed and somewhat specialized brush on second joint of labial palpi, approaching that of *Ypsolophus*; but otherwise in general habitus, wing form, and venation it agrees well with *Gelechia* as here defined, and I do not believe it can be retained as a natural separate genus in view of the many intermediate forms found between it and normal *Gelechia* species.

Pseudochelaria Dietz has justly been made a synonym of *Gelechia* by Lord Walsingham and J. Hartley Durrant.¹

From the examination of the supposed type of Lord Walsingham's genus of that name, *pennsylvanica* Dietz (Walsingham manuscript), which is now in Dr. Dietz's possession, I am unable to see why a new genus should be erected for it as Lord Walsingham suggests, and have, consequently, included that species also in the present genus. Some mistake has likely been made.

The genus *Catastega* Clemens, which was erected solely on larval food habits, I had at a time suspected to be synonymous with *Gelechia*, and it is so placed in Dr. Dyar's List of American Lepidoptera. I had reached this conclusion by breeding *Gelechia scrotinella* Busck, which has the identical and very peculiar life mode described by Clemens for the genus *Catastega*, and I surmised that Clemens' species, when bred, might turn out to belong to the same group.

Since then, however, Dr. Dyar has succeeded in breeding what must be regarded as type of Clemens' genus, the oak feeding *timidella*, and it turns out to be a Tortricid (not yet determined,² because of rubbed condition of the specimens).

¹ Ent. Mo. Mag. 1902, p. 28.

² For this reason *Catastega*, with its three species, was retained in Dr. Dyar's List of American Lepidoptera under *Gelechia*, as it was not known where else to place them.

This and the two other species, which were placed heading the list of unrecognized species of *Gelechia* have thus no place there, and need not give more trouble in this group.

Under *Gelechia* it has been necessary to place not only such species which have been recognized by the writer as belonging to the genus, but also all those species which have been described as or referred to *Gelechia*, but which at present are unknown and therefore of uncertain generic position; in fact, some of these evidently do not belong to *Gelechia*, but as their true genus can not be ascertained at present they must temporarily stand under *Gelechia* as described.

All these unplaced species I have put in section *B.*, which then merely indicates that such species are retained in the genus only on the authority of the original description. These species must of course be reckoned with when a new species is to be described in any *Gelechiid* genus. It is a tedious work, always more or less uncertain, to go over all these descriptions before one is reasonably sure not to make a synonym.

To insure myself as far as possible against this I have made for my own use a synoptic table of all these uncertain species, using such striking characters as can be gleaned from the descriptions, but even with this many descriptions must be gone over.

All species placed in section *A* can be relied upon as conforming with the definition of the genus *Gelechia* in all particulars, except when otherwise expressly remarked upon.

The following synoptic table includes only these recognized species:

Ground color black* or very dark uniform brown	1
Ground color not black or dark uniform brown.....	21
1. With head canary yellow.....	<i>aristella</i> , p. 866
Head not yellow.....	2
2. Forewings with white or whitish markings only.....	3
Forewing with dorsal edge rust red.....	<i>basquella</i> , p. 864
3. With head pure white.....	4
With head more or less mottled.....	14
4. With basal half of dorsal edge white.....	5
Dorsal edge not white.....	9
5. Entire dorsal edge white.....	<i>putella</i> , p. 865
Entire dorsal edge not white.....	6
6. With oblique white fascia at apical fourth.....	<i>unifasciella</i> , p. 865
Without such fascia.....	7
7. With abdomen and legs salmon colored.....	<i>abdominella</i> , p. 863
Abdomen not salmon colored.....	8
8. With white streak on basal half of costa.....	<i>sistrella</i> , p. 862
Without such streak.....	<i>dentella</i> , p. 862
9. With thorax white.....	10
Thorax not white.....	12
10. Forewings with white fascia and costal spots.....	<i>albilorella</i> , p. 861
Forewings without such fascia and spots.....	11
11. Forewings with faint ochreous white dots on disk.....	<i>minimaculella</i> , p. 867
Forewings without such dots.....	<i>thoracalbella</i> , p. 867

12. Forewings with white markings sharply defined.....	13
White markings diffused.....	<i>continua</i> , p. 859
13. Forewings with white spot on fold.....	<i>quinella</i> , p. 856
Forewings without white spot on fold.....	<i>cercerisella</i> , p. 855
14. With dorsal edge from base to cilia white.....	<i>packardella</i> , p. 866
Dorsal edge not white.....	15
15. With white oblique costal streak at basal third.....	16
Without such streak.....	18
16. With complete white fascia at apical third.....	<i>lagubrella</i> , p. 861
Without such fascia.....	17
17. Face and second joint of labial palpi white.....	<i>coloradensis</i> , p. 857
Face and second joint of labial palpi dark.....	<i>arizonella</i> , p. 856
18. With angulate white fascia at apical third.....	19
Without such fascia.....	20
19. Basal part of forewings lighter, sprinkled with white.....	<i>trophella</i> , p. 860
Basal part of forewings not lighter than rest of wing.....	<i>binaculella</i> , p. 859
20. Second joint of labial palpi light ochreous white.....	<i>trialbamaculella</i> , p. 858
Second joint of labial palpi dark.....	<i>confusella</i> , p. 859
21. Forewings brick red.....	<i>panella</i> , p. 889
Forewings not brick red.....	22
22. Apical edge of forewing and cilia rose.....	<i>ribesella</i> , p. 860
Forewings not rose.....	23
23. Ground color pure white.....	<i>fuscoteniella</i> , p. 890
Ground color not pure white.....	24
24. Apical third of forewings white.....	<i>abella</i> , p. 889
Apical third of forewings not white.....	25
25. Forewings with ocellate discal spots.....	26
Forewings without ocellate spots.....	28
26. Ground color dark purplish brown.....	<i>discoocellella</i> , p. 874
Ground color not brown.....	27
27. Ground color whitish gray.....	<i>bianulella</i> , p. 873
Ground color ochreous white.....	<i>obscuraozellella</i> , p. 878
28. Forewings without any distinct markings.....	29
Forewings distinctly marked.....	31
29. Forewings dark steel gray.....	<i>anarsiella</i> , p. 874
Forewings not dark steel gray.....	30
30. Ground color light ochreous.....	<i>rileyella</i> , p. 887
Ground color grayish white.....	<i>obscurousuffusella</i> , p. 888
31. Dorsal edge conspicuously lighter than costal edge.....	32
Dorsal edge not lighter than rest of wing.....	34
32. Base of forewings light ochreous.....	<i>mediofusella</i> , p. 885
Base of forewings not light.....	33
33. Entire thorax light ochreous.....	<i>hibiscella</i> , p. 869
Only central part of thorax ochreous.....	<i>ochrostrigella</i> , p. 869
34. Second joint of labial palpi deep black.....	35
Second joint of labial palpi not black.....	36
35. Forewings with indistinct white markings.....	<i>albisparsella</i> , p. 877
Forewings without white markings.....	<i>unctulella</i> , p. 878
36. Forewings without any transverse markings.....	37
Forewings with costal spots or other transverse markings.....	41
37. Forewings uniformly longitudinal streaked without other markings.....	38
Forewings with other markings.....	39
38. Forewings brownish.....	<i>ochreousuffusella</i> , p. 867
Forewings gray.....	<i>striatella</i> , p. 868

39. With heavy black longitudinal streak on fold.....	<i>variabilis</i> , p. 871	40
Without such streak.....		40
40. Forewings strongly mottled with dark fuscous spots.....	<i>undulata</i> , p. 888	
Forewings without such spots.....	<i>petasitis</i> , p. 888	
41. Dorsal base of forewing darker than general color of wing.....		42
Base of dorsum not darker than general color of wing.....		44
42. With angulated whitish fascia at apical third.....		43
Without such fascia.....	<i>cockerelli</i> , p. 871	
43. With oblique light band at basal third.....	<i>craslinghami</i> , p. 885	
Without such band.....	<i>pennsylvanica</i> , p. 885	
44. With white or whitish markings at apical third.....		45
Without white markings at apical third.....		60
45. With longitudinal deep black line on fold.....	<i>trilineella</i> , p. 873	
Without such line.....		46
46. With complete fascia at apical third.....		47
Fascia more or less interrupted or absent.....		57
47. With head unmottled ochreous.....	<i>monumentella</i> , p. 888	
Head more or less mottled.....		48
48. Forewings with vein 3 and 4 stalked.....	<i>conclusella</i> , p. 887	
Forewings with veins 3 and 4 separate.....		49
49. Forewings with longitudinal black line before apex.....	<i>sequax</i> , p. 884	
Without such line.....		50
50. With large black discal spot reaching up to costal edge.....	<i>occidentella</i> , p. 884	
Without such spot.....		51
51. Fascia strongly outwardly angulated.....		52
Fascia nearly straight.....		55
52. Face white.....		53
Face not white.....		54
53. Tuft on second joint of labial palpi large, much longer at base than at apex,	<i>versutella</i> , p. 878	
Tuft on second joint short and even in its entire length.....	<i>lyuceella</i> , p. 879	
54. Central part of underside of abdomen pure ochreous white.....	<i>nigrimaculella</i> , p. 880	
Underside of abdomen dark mottled.....	<i>bimimaculella</i> , p. 881	
55. With dark costal spot at basal third.....	<i>bicostomaculella</i> , p. 879	
Without such spot.....		56
56. Terminal joint of labial palpi with white annulation before tip.....	<i>tephriacella</i> , p. 886	
Terminal joint of labial palpi without annulation.....	<i>dyariella</i> , p. 877	
57. Basal half of costa whitish.....	<i>pseudocacaciella</i> , p. 881	
Basal half of costa not whitish.....		58
58. First abdominal segments velvety ochreous above.....	<i>scrotinella</i> , p. 882	
First abdominal segments not velvety ochreous above.....		59
59. Forewings with raised scales.....	<i>maculimarginella</i> , p. 881	
Forewings without raised scales.....	<i>vernella</i> , p. 884	
60. With base of costa black.....	<i>lindenella</i> , p. 876	
Base of costa not black.....		61
61. With horny frontal prominence.....	<i>barucsiella</i> , p. 875	
Without such.....	<i>pravinominella</i> , p. 875	

A. — *Recognized Species.*

GELECHIA CERCERISELLA Chambers.

Depressaria cercerisella CHAMBERS, Can. Ent., IV, 1872, pp. 108, 129, 147, 148.
Gelechia cercerisella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 110, 142. —
 WALSINGHAM, Trans. Am. Ent. Soc. Phila., 1882, p. 177. — RILEY, Smith's

List Lep. Bor. Am., No. 5334.—BUSCK, Dyar's List Amer. Lep., No. 5714, 1903.

Gelechia olympiadella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 259, pl. III, fig. 15.—CHAMBERS, Can. Ent., IX, 1877, p. 24; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5433.

Not *Gelechia cercerisella* CHAMBERS, Can. Ent., VI, 1874, pp. 230-231; Can. Ent., IX, 1877, p. 23.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., 1882, p. 179.

Chambers found what he supposed to be a variety of the species in Texas with an additional white spot on the fold and consequently made *Gelechia quinella* Zeller, which is this supposed variety a synonym of the present species. This "variety" is truly *quinella* Zeller, but is a quite distinct species, while Zeller's *olympiadella*, as the description, figure, and types in Cambridge Museum show, is the same as Chambers' *Cercis* feeding species. Zeller points out well the differences between the two species.

The present species is one of the commonest *Gelechiids* in the vicinity of Washington, and its pretty larva, well described by Chambers, can be found all summer spinning up the leaves of redbud. There are at least two generations in this locality. The imagoes of one brood issue about September 1, and the following brood overwinters as pupa and comes forth as imago in early May.

In U. S. National Museum are authentic specimens, received and labeled by Chambers, besides large bred series from District of Columbia, and captured specimens from Kansas and Texas.

GELECHIA QUINELLA Zeller.

Gelechia quinella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien., XXIII, 1873, p. 260, pl. III, fig. 14.—CHAMBERS, Can. Ent., IX, 1877, p. 23.—BUSCK, Dyar's List Amer. Lep., No. 5715, 1903.

Gelechia cercerisella var. CHAMBERS, Can. Ent., VI, 1874, p. 231; IX, 1877, p. 23.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., 1882, p. 177.

This species must, according to the explanation given under the previous species, stand as a good species, distinct from *cercerisella*—Chambers=*olympiadella* Zeller.

I have examined, besides Zeller's types in the Cambridge Museum, the specimens there, originally belonging to Salem Academy of Natural History, which Lord Walsingham had before him in 1882 with his blue labels, nos. 976 and 989.

Authentic specimens of Chambers' supposed variety of *cercerisella* are found in Cambridge Museum and in U. S. National Museum, where are also several other specimens, all like the type and Chambers' specimens from Texas.

GELECHIA ARIZONELLA, new species.

Gelechia arizonella BUSCK, Dyar's List Amer. Lep., No. 5716, 1903.

Antennae black; labial palpi with dense slightly furrowed brush, black; the inside of the second joint and the middle of the terminal

joint with sparse whitish scales intermixed. Face, head, and thorax whitish, but heavily overlaid with dark fuscous scales; top of head and middle of thorax lighter than face and shoulders. Forewings deep bronzy black with four white markings, namely, one large outwardly oblique white costal streak near base, the lower tip of which crosses the fold; one nearly elliptical white spot on the middle of the wing; one triangular white costal spot at the beginning of the cilia, and opposite this a smaller dorsal white spot.

The spots are identical with those found in the two preceding species, *cercerisella* and *quinella*, except that the second costal spot in the former and the two middle spots of the latter have been replaced by the single central spot in *arizonella*.

Hindwings as broad as forewings; light silvery fuscous, darker along costa and toward the tip. Cilia a shade lighter. Abdomen light fuscous with a metallic purple sheen; each joint is fringed posteriorly with whitish scales, and the two first joints are velvety yellowish above.

Legs dark fuscous; tarsal joints narrowly tipped with whitish.

Alar expanse.—13 to 15 mm.

Habitat.—Arizona.

Type.—No. 6373, U.S.N.M.

Collected by Mr. E. A. Schwarz in Santa Rita Mountains, Arizona, in May.

Very near the foregoing species and the following, but at once distinguished by its dark head, its different wing spots, and its unbarred legs.

GELECHIA COLORADENSIS, new species.

Gelechia coloradensis BUSCK, Dyar's List Amer. Lep., No. 5717, 1903.

Antennæ black; labial palpi with well-developed brush; second joint white, slightly sprinkled with dark scales above, terminal joint black with white tip. Face white; head and thorax uniform dark purplish black. Forewings deep purplish black with five pure white markings, namely, an outwardly oblique costal white streak near base, reaching the fold; an elliptical white spot on the middle of the wing; an angulate white costal spot at the beginning of the cilia; an opposite small dorsal white spot and a small white dot on the fold, below and forward of the central spot. Just before apex are found a few single white scales.

The ornamentation of the wing is precisely similar to that of the preceding species, *arizonella* Busck, with the addition of the last mentioned small white dot on the fold. Hindwings as broad as forewings, dark fuscous.

Abdomen above purplish black, below whitish. Legs dark fuscous with broad white bars on tibia and tarsi and with posterior coxæ white.

Alar expanse.—15 to 16 mm.

Habitat.—Colorado, Florida, South Carolina.

Type.—No. 6374, U.S.N.M.

This species is very close to the foregoing three species, especially to *arizonella* Busck, but at once distinguished from this by its pure white face and black head, by its light palpi and white barred legs, as well as by the slight difference in wing ornamentation.

The name of the species is a misnomer because while the types of the species came from Colorado I have subsequently identified it from Florida and South Carolina.

GELECHIA TRIALBAMACULELLA Chambers.

Gelechia trialbamaculella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 250; Bull. U. S. Geol. Surv., III, 1878, p. 147—RILEY, Smith's List Lep. Bor. Am., No. 5497, 1891—BUSCK, Dyar's List Amer. Lep., No. 5718, 1903.

Gelechia epigzeella CHAMBERS, Journ. Cinn. Soc. Nat. Hist., III, 1881, p. 289.—RILEY, Smith's List Lep. Bor. Am., No. 5359, 1891.

Types of both species with Chambers' labels on the pins are found in the Museum of Comparative Zoology in Cambridge, and prove, as the descriptions would indicate, that it is only one species twice described.

A large bred series, showing considerable variation in the white markings, is found in U. S. National Museum, determined by Lord Walsingham as *epigzeella*.

Food plant—*Vaccinium stamineum*.—The following are the notes on this series in the U. S. Department of Agriculture, given under No. 2788:

An apparently very numerous larva of a skeletonizer on *Vaccinium stamineum* was found in Virginia (presumably by Mr. Theo. Pergande and near Washington City) on July 16. The larva fastens together two or more leaves and feeds between them on the epidermis, forming from its frass a tube, which is open at both ends. The larva is about 8 mm. long, pale dirty yellowish or greenish yellow, with six darker yellow stripes, head and cervical shield dark yellow; moths issued from July 26 to August 17.

Chambers' type was bred from the nearly related *Epigzeæ repens*.

In U. S. National Museum is another series of apparently this same species bred from sweet fern, *Comptonia asplenifolia*, and also identified by Lord Walsingham as *epigzeella* Chambers. This would be an unusually diverse food plant for a Gelechiid, and I was suspicious that the latter series would prove another species, as it eventually may. But the rather ample material can not be separated at present except by the labels, and the notes on the larvæ are so similar that for the time being at least I must assume all to be one species.

Should it ultimately prove to be two species by more accurate observations on the larvæ, the species on *Comptonia* might properly be

given Chambers' first name, *trialbamacudella*, and his second name be retained for the feeder on *Vaccinium* and *Epigaea*.

GELECHIA CONFUSELLA Chambers.

Gelechia confusella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 251; Bull. U. S. Geol. Surv., IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5342, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5719, 1903.

Depressaria persicivella MURTFELDT, Rep. Mich. St. Agr. Coll., 1899.

Gelechia persicivella MURTFELDT, Can. Ent., XXXII, 1900, p. 164.

Food plant.—*Prunus persica*.

Habitat.—Michigan.

Cotypes of Miss Murtfeldt's species are in U. S. National Museum under type No. 4697.

The species is very close to the foregoing and I have no doubt is the same as Chambers' *Gelechia confusella*, the type of which is lost, but the description of which tallies in every detail with the peach feeder.

GELECHIA BIMACULELLA Chambers.

Depressaria bimaculella CHAMBERS, Can. Ent., IV, 1872, pp. 108, 129, 147, 148.

Gelechia bimaculella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5326, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5720, 1903.

Gelechia (?*Lita*) *ternariella* ZELLER, Verh. k. k. zool.-bot. Gesell. Wien., XXIII, 1873, p. 264, pl. III, fig. 19.

Gelechia ternariella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5491, 1891.

Gelechia sylvacoilella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 86, 147.—RILEY, Smith's List Lep. Bor. Am., No. 5489, 1891.

Type No. 440 in the U. S. National Museum of *Depressaria bimaculella*, labeled in Chambers' handwriting and dated 1872, agrees with his type specimen in the Museum of Comparative Zoology in Cambridge and shows that it is identical with Zeller's *ternariella*, type of which, in excellent condition, is also found in the Cambridge Museum. The type in U. S. National Museum bears besides Chambers' name label also another folded label in his handwriting: "Congeneric with *cercorisella* and perhaps a true *Gelechia*." It also bears Lord Walsingham's blue label no. 1168.

The type of *Gelechia sylvacoilella* Chambers is lost, but the description agrees well with the present somewhat variable species, and it seems proper to regard it as a variety of it, as suggested by Chambers.

Habitat.—Kentucky, Texas.

GELECHIA CONTINUELLA Zeller.

Gelechia continuella ZELLER, Isis, 1839, p. 198.—STAUDINGER and REBEL, Cat. Lep. Eur., II, No. 2597, 1901.—MOESCHLER, Wiener ent. Monatschr., 1864, p. 200.—GROTE, Can. Ent., IV, 1872, p. 126.—RILEY, Smith's List Lep. Bor. Am., No. 5343, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5721, 1903.

Gelechia trimaculella PACKARD, Proc. Bost. Soc. Nat. Hist., XI, 1867, p. 61.

Gelechia albomaculella CHAMBERS, Can. Ent., VII, 1875, p. 209; Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5306, 1891.

Moeschler originally recorded *continuella* from Labrador. In the Museum of Comparative Zoology in Cambridge are Packard's two types of *trimaculella*, also described from Labrador.

So far as the specimens, which are in poor condition, permit comparison, they agree in every respect with authentic European specimens of *continuella* Zeller in U. S. National Museum. From the Beinger collection in Laval University, Quebec, I have obtained the unique type of Chambers' *Gelechia albamaculella*. It is in poor condition, without palpi and wings on one side, but recognizable, and undoubtedly authentic, with Chambers' label on the pin. It is same species as *trimaculella* Packard.

The types of the latter in Cambridge bear Lord Walsingham's blue labels no. 838-839, corresponding to his identification in his notebook,¹ *trimaculella* Packard.

The American specimens agree with the European in having veins 3 and 4 and 6 and 7 on hindwing shortstalked.

GELECHIA RIBESSELLA Chambers.

Gelechia ribesella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 290; Bull. U. S. Geol. Surv., III, 1877, p. 128; Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5467, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5722, 1903.

The unique type of this species is in the Museum of Comparative Zoology in Cambridge in good condition. It is a fine, well-described, and easily recognized species.

Chambers bred it from currant in Colorado at an altitude of 8,500 feet.

In the U. S. National Museum is a fine series, bred last summer from currant in Colorado by Dr. Harrison G. Dyar.

GELECHIA TROPHELLA, new species.

Gelechia trophella Busck, Dyar's List Amer. Lep., No. 5723, 1903.

Antennæ light silvery fuscous, with narrow black annulations. Second joint of labial palpi with well-developed brush, longer at base than at apex; silvery white liberally mottled with black; underside of brush black; terminal joint black, slightly sprinkled with white scales. Lower part of face and tongue ochreous; upper part of face, head, and thorax light fuscous, intermixed with white and black metallic scales. Basal half of forewings dark iridescent fuscous, liberally intermixed with white and black scales. At basal third is an oblique outwardly directed black costal streak, somewhat wider at its lower end on the cell. Outer half of forewings shining black, with sparse white scales around the edges. At apical third is a transverse, per-

¹ See preface, p. 768.

pendicular, slightly outwardly angulated white fascia across the wing. Cilia purplish white, with sparse black scales intermixed.

Hindwings as broad as forewings, light shining fuscous; cilia lighter yellowish fuscous. Abdomen light iridescent purplish fuscous. Legs bluish black, mottled with white scales; tarsi dark purple, with each joint tipped with white.

Alar expanse.—15 to 16 mm.

Food plant.—Oak.

Habitat.—Colorado.

Type.—No. 6375, U. S. N. M.

This species comes nearest *continella* Zeller, but has the fascia well defined and is easily distinguished from that species by its dark head and long brush on the labial palpi.

The types were bred by Dr. Harrison G. Dyar, who has given me the following notes on the larva:

Larva.—Head and cervical shield black; body pale, thickly mottled with red brown, obscurely longitudinally lined and leaving pale spaces about the minute black tubercles. Dorsal line geminate, irregular; sublorsal broader, blotched below tubercle i; lateral and two subventral lines obscure. Thoracic feet black; anal plate brown bordered.

On oak in the Platte Canyon, Colorado. Imago June 18.

GELECHIA LUGUBRELLA Fabricius.

Gelechia lugubrella FABRICIUS, Ent. Syst., III, 1794, 2, 299, 54.—STAUDINGER and REBEL, Cat. Lep. Eur., II, No. 2617, 1901.—BUSCK, Dyar's List Amer. Lep., No. 5724, 1903.

In Professor Fernald's collection are two specimens from Orono, Maine, determined by Lord Walsingham as *Gelechia lugubrella* Fabricius. They bear his blue labels no. 99 and 213 and undoubtedly belong to this European species, which must thus be included in the American list.

In the U. S. National Museum is a good series of European specimens.

The species is very distinct from its nearest allies and easily recognized by its two white wing markings, the oblique white streak at basal third and the narrow inwardly curved white fascia at apical third.

GELECHIA ALBILORELLA Zeller.

Gelechia albimorella ZELLER, Verh. k. k., zool.-bot. Gesell. Wien, XXIII, 1873, p. 261, pl. iii, fig. 16.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5303, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5725, 1903.

Gelechia trifasciella CHAMBERS, Cim. Quart. Journ., II, 1875, p. 252; Can. Ent., IX, 1877, p. 24; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5498, 1891.

Type No. 464, in the U. S. National Museum, of *trifasciella*, with Chambers' label on the pin, is identical with two types in Cambridge

Museum; also with Chambers' labels. One of these bears Lord Walsingham's blue label No. 1004, corresponding to his identification in his notebook,¹ *trifasciella* Chambers.

These types agree exactly with Zeller's description and figure of *albilorella*, a specimen of which, identified by Lord Walsingham, is in U. S. National Museum.

This striking species is common in collections from Arizona, Colorado, and Texas.

GELECHIA DENTELLA, new species.

Gelechia dentella Busck, Dyar's List Amer. Lep., No. 5726, 1903.

Antennæ dark fuscous, with lighter faint annulations. Labial palpi with well-developed brush; second joint yellowish white; terminal joint white, with a fuscous annulation before the tip.

Face, head, and thorax yellowish white; shoulders black. Forewings black and yellowish white, as follows: Costal half from base to apical, two-fifths black, and entire apical two-fifths black except two small opposite costal and dorsal spots, which are yellowish white. Dorsal half of wing from base to apical, two-fifths yellowish white. The white part projects upward at apical two-fifths to the costal edge and has another slight projection into the costal black part at basal third of the wing. Cilia black.

Hindwings broader than forewings, light yellowish gray; abdomen light yellowish fuscous; legs yellowish white, barred with black.

Alar expanse.—9 to 10 mm.

Habitat.—Phoenix, Arizona.

Type.—No. 6376, U.S.N.M.

Cotypes in collection of Mr. William D. Kearfott, to whom I am indebted for this and the two following similar species.

Close to the following two species, *sistrella* and *abdominella*, but distinguished from them by the absence of any white on basal three-fifths of costal half of forewing.

GELECHIA SISTRELLA, new species.

Gelechia sistrella Busck, Dyar's List Amer. Lep., No. 5727, 1903.

Antennæ black, with narrow, indistinct white annulations; labial palpi with well-developed brush; second joint white; terminal joint white, sprinkled with black, and with tip black; face, head, and thorax white; shoulders black; forewing, deep black and pure silvery white, as follows: A broad longitudinal black in the middle of the wing, equidistant from the costal and dorsal edge, starting at base of costa and reaching one-half of the length of the wing, where it turns

¹See preface, page 768.

sharply rectangularly upward, reaching costal edge and thus inclosing a narrow, longitudinal costal white patch; apical two-fifths black, with two large rounded opposite costal and dorsal spots, white. The rest of the wing—that is, the basal half of the dorsal edge and a perpendicular, nearly straight fascia just outside the middle of the wing—is white. Cilia black, tipped with whitish; hindwings broader than forewings, silvery fuscous; abdomen dark fuscous and tuft yellowish; legs white, with black bars on the outside.

Alar expanse.—9 to 10 mm.

Habitat.—Phoenix, Arizona.

Type.—No. 6377, U.S.N.M.

Cotypes in collection of Mr. William D. Kearfott. Very similar to the preceding species, but at once distinguished by the white basal costal patch.

GELECHIA ABDOMINELLA, new species.

Gelechia abdominella Busck, Dyar's List Amer. Lep., No. 5728, 1903.

Antennæ black, with sharp white annulations. Labial palpi with second joint white; brush well developed; terminal joint white, with slight fuscous shading in front; tip white.

Face, head, and thorax white, with a faint ochereous tint; shoulders black.

Forewings black and white, as follows: Extreme base of costa black; a large triangular costal spot before the middle of the wing, with tip reaching beyond the fold, black, with a central dot on the costa, white. Apical two-fifths of wing black, with a costal and dorsal triangular white spot at the beginning of the cilia nearly or quite reaching each other with their thinly extended tips. Rest of forewing—that is, the dorsal three-fifths, with two upward projections reaching the costal edge on each side of the costal black triangular spot—white, with a faint ochereous tint. Cilia blackish.

Hindwings broader than forewings, light silvery gray. Abdomen and hindlegs light silvery salmon red; forelegs white, barred with black.

Alar expanse.—9 to 10 mm.

Habitat.—Phoenix, Arizona.

Type.—No. 6378, U.S.N.M.

Cotypes in collection of Mr. William D. Kearfott.

Very similar in size and general habitus to the two foregoing species; so similar that by superficial examination they might all be taken to represent one species, which, however, the constancy in their differences clearly shows that they are not. The present species is easily recognized by its peculiarly colored abdomen, as well as by the isolated triangular costal black spot.

GELECHIA BASQUELLA Chambers.

Oecophora basquella CHAMBERS, Can. Ent., VII, p. 92.

Gelechia basquella CHAMBERS, Can. Ent., VII, 1875, p. 124.—BUSCK, Dyar's List Amer. Lep., No. 5729, 1903.

Gelechia (?) *basquella* CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 87, 142.

Gelechia (*Bryothropha*?) *basquella* WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 178.

Gelechia basquella RILEY, Smith's List Lep. Bor. Am., No. 5329, 1891.—WALSINGHAM, Proc. Zool. Soc. Lond., 1897, p. 75.

Gelechia costipunctella MÖSCHLER, Abhand. d. Senckenb. naturf. Ges., XVI, 1889, p. 334.—WALSINGHAM, Proc. Zool. Soc. Lond., 1892, p. 519.

Chambers' type is in the Museum of Comparative Zoology, Cambridge, and is identical with specimens in Professor Fernald's collection and in Dr. William Dietz's collection, named by Lord Walsingham, who recorded this species from the West Indies and found the synonymy with Möschler's *costipunctella*.

I have collected this species at light in the District of Columbia and found its foodplant and larva there; I have also taken specimens in Kentucky, Key West, Florida, Porto Rico, and St. Thomas, West Indies. In the National Museum are, besides these specimens, others from Kansas, Iowa, and Texas.

The species has veins 3 and 4 in the forewings stalked, but agree otherwise with the definition of the present genus, and seems close to the three foregoing species. Veins 6 and 7 in hindwings are stalked.

Foodplant.—*Cassia chamaecrista*.

The larva is when full-grown about 10 mm. long, with head and thoracic shield and feet shining black and with the three thoracic segments, except anterior part of the third joint, deep purplish red; the rest of the body is green, with very small, deep black tubercles emitting short dark hairs.

Dr. Dyar has kindly drawn up the following technical description:

LARVA.—Head rounded, bilobed, full, oblique and retracted; mouth projecting; the labium and spinneret prominent; clypeus high, triangular, antennæ small; shining black, labium, and epistoma pale; width, .6 mm. Body cylindrical, normal; joints 2 to 3 and 12 to 13 tapering; thoracic feet distinct, the joints black ringed; abdominal feet slender, rather small, normal, the crochets in a complete ring about the small, circular planta; cervical shield large, transverse, rounded on the posterior corners, shining black, cut by a fine, faint, pale dorsal line; joints 2 and 3 entirely dark vinous except the neck in front of the cervical shield; joint 4 in the incisure in front and in a broad band on the posterior third of the same dark vinous, extending even on the venter. The white area thus formed on the anterior part of joint 4 on the otherwise uniformly red thorax appears irregularly edged and lumpy. Rest of body whitish, immaculate, greenish from the blood. Tubercles small, round, black but distinct, bearing short, stiff, dark setæ. On the thorax tubercles ia and ib are separate, iia and iib, iv and v united in pairs. On joint 3 the tubercle plates are large of ib, iia + iib and iv + v, but on joint 3 they are small, and the paired tubercles stand separate though contiguous; on the prothorax the prespiracular and subventral tubercles are large. On the abdomen tubercle i is dorsal and cephalad to ii, iii is near to the spiracle, above it, iv and

v contiguous, in line, vi subventral posteriorly, vii of three contiguous tubercles on the anterior side of the leg base, viii on the inner side of the leg base. Spiracles small, black ringed; anal shield pale brown, distinct; anal feet with brownish outer shields.

GELECHIA PAULELLA, new species.

Gelechia paulella Busck, Dyar's List Amer. Lep., No. 5730, 1903.

Antennæ dark brown with indistinct yellowish annulations. Labial palpi yellowish white with base of second joint and extreme tip of terminal joint brown. Brush well developed undivided face; head and thorax yellowish white, shoulders dark brown. Forewings shining dark blackish brown with white markings. Entire dorsal edge white, this color reaching up the fold except right at base and slightly crossing the fold with an oblate upward projection at apical third of the wing. Beginning at basal one-fourth of costa and reaching the costal white part is a sharply defined outwardly directed white fascia. At apical fourth of the wing and nearly perpendicular on the costal edge is another narrower white fascia, somewhat dilated on the costal edge.

Between these two fasciæ, at the middle of the wing, is a large nearly semicircular white costal spot.

Cilia white, sparsely sprinkled with dark brown scales.

The white markings show indistinctly through on the underside of the wings.

Hindwing broader than forewings, silvery pale gray, nearly white; cilia yellowish.

Abdomen light yellowish fuscous. Legs yellowish; tarsi sprinkled with fuscous.

Alar expanse.—13 to 23 mm.

Habitat.—Arizona, Colorado.

Type.—No. 6379, U.S.N.M.

This distinct and fine species is described from numerous specimens collected in Arizona and Colorado and received from several sources (Schwarz, Dyar, Gillette, Barnes).

The specimens vary very much in size, the largest being by far the commonest, but the ornamentation is constant, and I have no hesitation in including the small specimens as the same species.

The species comes nearest the following and *Gelechia packardella* Chambers, but clearly has a quite different ornamentation.

GELECHIA UNIFASCIELLA, new species.

Gelechia unifasciella Busck, Dyar's List Amer. Lep., No. 5731, 1903.

Antennæ deep black. Labial palpi with second joint pure white except the base, which is black on the outside; brush well developed, longer at base than at apex, not furrowed; terminal joint black, sprinkled on the outside toward the base with white scales.

Face, head, and thorax pure silvery white, patagia black. Forewings deep bronzy black, with dorsal edge below the fold, from base to cilia white, and with a white narrow inwardly curved fascia at apical fourth.

The black part of the wing is found, under a lens, to be slightly sprinkled with minute bluish white atoms.

Cilia white sprinkled with black scales. Hindwings broader than forewings, shining light fuscous, cilia with a yellowish tint.

Abdomen light silvery and purplish fuscous, with the two first joints yellowish above, below sprinkled with white.

Legs purplish black, sprinkled with white scales and with each joint slightly tipped with white.

Alar expanse.—18 mm.

Habitat.—Arizona.

Type.—No. 6380, U.S.N.M.

A striking and distinct species near the foregoing, collected at Williams, Arizona, in July, by Mr. H. S. Barber.

GELECHIA PACKARDELLA Chambers.

Gelechia packardella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 143; IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5437, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5732, 1903.

I have not yet definitely determined this species, the type of which is lost, but it evidently belongs in this immediate group and will, when found, easily be identified from the description.

Habitat.—Colorado.

GELECHIA ARISTELLA, new species.

Gelechia aristella BUSCK, Dyar's List Amer. Lep., No. 5733, 1903.

Antennæ dark, shining brown. Labial palpi with well-developed spreading furrowed brush, second joint light canary yellow, terminal joint whitish, sprinkled with sparse light fuscous scales. Face, head, and thorax light, clear canary yellow; patagia black.

Forewings deep purplish black with two conspicuous broad longitudinal canary-yellow streaks; one from base along and immediately below the costal edge to apical third; the other, which is broader, from base along and including the entire dorsal edge nearly to apex. Cilia dark purplish fuscous.

Hindwings much broader than forewings, light silvery fuscous, cilia still a shade lighter.

Abdomen light purplish gray; anterior joints above velvety yellowish.

Legs purple, sprinkled with white scales.

Alar expanse.—22 mm.

Habitat.—Arizona.

Type.—No. 6381, U.S.N.M.

Collected in July at Williams, Arizona, by Mr. H. S. Barber.

This beautiful large species, which can not well be mistaken for any described American species, may be at once distinguished by the yellow coloring and the longitudinal ornamentation.

GELECHIA THORACEALBELLA Chambers.

Gelechia thoracealbella CHAMBERS, Can. Ent., VI, 1874, p. 235; Cinn. Quart. Journ. Sci., II, 1875, p. 252; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5492, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5734, 1903.

Types of this species were examined in the Museum of Comparative Zoology in Cambridge and found to be identical with specimen in U. S. National Museum bearing Chambers' label, *Gelechia thoracealbella*.

Both are in poor condition, but recognizable from the description, and unlike any other species known to me.

Habitat.—Texas.

GELECHIA MINIMACULELLA Chambers.

Gelechia minimaculella CHAMBERS, Can. Ent., VI, 1874, p. 235.—BUSCK, Dyar's List Amer. Lep., No. 5735, 1903.

Gelechia minimaculella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5410, 1891.

This species, of which the unique type is found in Cambridge, is very similar to the foregoing, *thoracealbella* Chambers, but distinguished by the small ochreous discal dots.

The type is in comparatively good condition, except lacking the palpi; but it is unspread, and consequently the venation has not been examined. I am, however, quite assured from its general appearance that it is a true *Gelechia*. It is a large blackish-brown species with light ochreous head, thorax, and (according to Chambers) labial palpi. The very faint small ochreous markings on the forewings are well described by Chambers.

Habitat.—Texas.

GELECHIA OCHREOSUFFUSELLA Chambers.

Gelechia ochreosuffusella CHAMBERS, Can. Ent., VI, 1874, p. 236; Cinn. Quart. Journ. Sci., II, 1875, p. 255; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5430, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5736, 1903.

Gelechia depressostrigella CHAMBERS, Can. Ent., VI, 1874, p. 236; Bull. U. S. Geol. Surv., III, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5350, 1891.

Gelechia depressostrigella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 255.

Type no. 450 in the U. S. National Museum of *depressostrigella* is like the type in Professor Fernald's collection of that species and

the same as eight types in the Museum of Comparative Zoology in Cambridge labeled by Chambers *depressostrigella*.

All of these types agree with the description and are undoubtedly authentic.

So far as known to me no authentic specimen labeled *ochreosufusella* is in existence, and the above synonymy is established merely on Chambers' evidence.

The two species are described from Texas, one right above the other,¹ and there, Chambers thinks, they are two different species, though he says that they resemble each other. He writes that the color of head and palpi are different in the two species, but does not give the color of one of them (*depressostrigella*), and the color given for the other suits his own authentic specimens of the first.

Later² he corrects his description somewhat and says that they may be one and the same species.

As the many types of *depressostrigella* show some little variation, it seems under the circumstances admissible to place the two names as synonyms, thus lessening the previous long list of unknown species.

Should future collecting reveal two closely similar species, which with sufficient probability can be referred to the two species, then, of course, the second name should be resurrected and retained for the species represented by the types.

In the U. S. National Museum, besides the type, there is one specimen labeled by Lord Walsingham, *Gelechia depressostrigella*. This, as all the types, came from Texas.

GELECHIA STRIATELLA, new species

Gelechia striatella Busck, Dyar's List Amer. Lep., No. 5737, 1903.

Antennæ shining dark brown, slightly serrate toward the tip. Labial palpi with well-developed furrowed brush, ocherous white, thickly sprinkled with black and gray scales, underside of brush nearly black.

Face whitish; head and thorax clothed with light bluish gray scales, each scale slightly tipped with black or gray, which produces to the naked eye a uniform dark-gray color.

Forewings with ground color light whitish gray, thickly sprinkled with darker gray, brown, and black scales, which are arranged in indistinct narrow longitudinal darker lines, somewhat more pronounced in the apical part of the wing, but even there not clearly perceptible to the naked eye. Along the fold and at the dorsal cilia the wing is faintly suffused with ocherous. Cilia whitish, sprinkled with black dots.

¹ Can. Ent., VI, p. 236.

² Cinn. Quart. Journ. Sci., II, p. 255.

Hindwings a little broader than forewings, shining light ochereous fuscous; cilia golden gray.

Abdomen metallic yellowish fuscous, underside darker, sprinkled with black scales.

Forelegs on the outside black, on the inside whitish; tarsi black, each joint tipped with ochereous. The other legs are light gray, sprinkled with black scales; tuft on posterior tibial yellowish.

Alar expanse.—16 to 17.5 mm.

Habitat.—Arizona.

Type.—No. 6382, U.S.N.M.

This species is very near the foregoing, and I have tried hard to convince myself that it might be *ochreosuffusella* (distinct from *depressostrigella*), but I can not make the description apply.

The light whitish ground color and the fainter striation distinguish it from Chambers' ochereous brown species.

Described from more than forty specimens in good condition, all from Arizona, and mostly collected by Mr. E. A. Schwarz in Santa Rita Mountains in May.

This large series shows hardly any variation.

GELECHIA OCHREOSTRIGELLA Chambers.

Gelechia ochreostrigella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 247; Can. Ent., X, 1878, p. 54; Bull. U. S. Geol. Surv., IV, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5431, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5738, 1903.

Not *Gelechia ochreostrigella* CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 126.

Chambers described two different insects under the name *Gelechia ochreostrigella*, types of both of which I have examined in the Museum of Comparative Zoology in Cambridge.

The last described is a *Gnorimoschemat*, and will be found treated under that genus (p. 831).

The other (the present) species is a typical *Gelechia* quite similar to *ochreosuffusella*, but easily distinguished by its ochereous head and thorax and the dark, nearly black, basal costal part of the wing.

In the U. S. National Museum is a specimen from California, which was also the locality of the type.

GELECHIA HIBISCELLA, new species.

Gelechia hibiscella BUSCK, Dyar's List Amer. Lep., No. 5739, 1903.

Antennae dark brown, not annulated, slightly serrate toward the tip.

Labial palpi with well-developed spreading brush, yellowish white; second joint with a few black scales on the outside; terminal joint with tip and one annulation near base black.

Face, head, and thorax shining ochereous white; shoulders purplish black. Costal half of forewings dark brown, in some specimens nearly

black; dorsal half including apex light ochereous brown, in some specimens whitish. The limit between these two parts of the wing is not very definite and somewhat variable.

In the dark costal part are found lighter, yellowish brown, irregular patches, one large indistinct at the middle of the costa, one small rather more distinct costal spot at the beginning of the cilia and in some specimens others not well defined. In the dorsal light part of the wing are ill-defined darker shadings and the veins are indicated darker so as to produce a striate effect. On the fold at the basal one-third is a small nearly black spot which seems to be constant. Likewise is a row of black dots around the apical edge constant in all my specimens. The other markings are more or less varying.

Hindwings a little broader than forewings, light bluish fuscous; cilia yellowish. Abdomen yellow. Legs dark purple with yellowish white bars on the outside and with tarsal white annulations.

Alar expanse.—16 to 17 mm.

Habitat.—District of Columbia.

Food plant.—*Hibiscus moscheutos*.

Type.—No. 6383, U.S.N.M.

This species is quite near to the foregoing species, *ochreostrigella* Chambers, but not so conspicuously streaked and with light, dark annulated, third joint of labial palpi instead of the uniformly dark, nearly black, terminal joint in *ochreostrigella*.

I have reared this variable, but always easily recognized species repeatedly from the common swamp rose mallow.

The larva is rather large when full grown in proportion to the imago, being 22–23 mm. long and with greatest width 2.2 mm. It is cylindrical, only slightly tapering fore and back. Head rounded, shorter than wide, black with reddish brown vertex; width, 1.3 mm. First thoracic segment somewhat narrower than the following joint, reddish; thoracic shield black; width, 1.6 mm.; length, 0.7 mm.; straight in front and nearly straight posteriorly. Second thoracic segment dark reddish, with anterior part white above. Third thoracic segment and the rest of the body white; on the posterior half of this joint begin six wavy narrow interrupted longitudinal dark reddish dorsal lines, which run through on all the rest of the segments. These lines are darker in the young larvæ, which otherwise are like the full-grown larvæ. Tubercles shining deep black, bearing short black hairs; they are arranged conspicuously on the white part between the dark lines. Ventral part of the abdominal segments white. Thoracic feet black; abdominal prolegs normal, white, with a complete circle of brownish hooks.

The larva feeds on the leaves or in the capsules, generally in large numbers together; when ready to pupate they partially bite off one or

more leaves, which thus dry up and crumple and afford convenient shelter; or others find room in the dried fruit or between it and the large surrounding calyx. The species overwinters as larva, and two generations are found in this locality, the imagoes issuing from the hibernated larva in May and from the summer brood in August.

GELECHIA COCKERELLI, new species.

Gelechia cockerelli Busck, Dyar's List Amer. Lep., No. 5740, 1903.

Antenna dark brown with indistinct yellow annulations. Labial palpi are long and slender, brush on second joint only slightly developed; white with a few dark scales; terminal joint somewhat darker, yellowish. Face yellowish white. Head and thorax rust yellow, thorax with three longitudinal blackish lines.

Forewings light yellowish brown, with dark blackish brown markings; on dorsal edge near base is a large dark brown patch, therein differing from the foregoing similar *ochreostrigella* Chambers and *hibiscella* Busck, which both have dorsal base light, but costal base dark; in the present species the costal base is of the general color of the wing. At apical third is a blackish ill-defined costal spot, which runs out in a dark shade across the wing. Just before this spot is another smaller, more sharply defined costal blackish spot. Along the veins and in the disk are longitudinal dark lines, sharpest and darkest in the apical part of the wing, and each terminating at the base of the cilia in a deep black spot. These longitudinal streaks are interrupted at the end of the cell by a short thin perpendicular deep black streak, followed by a short light brown space. Cilia reddish yellow, slightly sprinkled with black.

Hindwings broader than forewings, yellowish fuscous; cilia yellowish.

Abdomen light brown. Legs light brown shaded with darker brown; tarsi blackish with each joint tipped with yellow.

Alar expanse.—15 to 16.5 mm.

Habitat.—New Mexico, Arizona.

Type.—No. 6384, U.S.N.M.

Collected at light in May in Mesilla Park, New Mexico, by Mr. T. D. A. Cockerell, after whom I take pleasure in naming this species. Also collected by Mr. E. A. Schwarz at Catalina Springs, Arizona, in April.

GELECHIA VARIABILIS, new species.

Gelechia variabilis Busck, Dyar's List Amer. Lep., No. 5741, 1903.

The insects which I shall describe under this name and as varieties of this species represent, in my opinion, undoubtedly only one species, but is the most variable Gelechiid with which I am acquainted (except

it be *Ypsolophus ligulellus* Hübner), and it will be necessary to describe at least some of the varieties separately.

It has seemed reasonable to me that one or more varieties of this evidently common Western species should have been described by Chambers as one or more species, and I have especially carefully compared this species with the descriptions of his several unrecognized species, but I am unable to find any which I could make apply and feel justified in adopting the name of.

The specimens which I regard as typical may be recognized from the following:

Antennæ brown, with indistinct lighter annulations. Labial palpi slender; second joint whitish, suffused with brown; the brush only slightly developed, but divided and with a longitudinal dark streak in the middle; terminal joint nearly uniform dark fuscous, the whitish ground color being entirely covered.

Face, head, and thorax light ochreous gray. Forewings light grayish yellow, slightly brownish toward the tip and with blackish brown longitudinal lines from base to apex, following the veins and becoming heavier and more blackish toward apex. Three short more pronounced heavy black longitudinal lines independent of the others are very conspicuous and are found, although modified in all the varieties; the first and shortest at base just within dorsal margin; the second on the fold, also starting more or less clearly from the base, but reaching its characteristic thickness and tone outside the first line and ending as a heavy line just before the middle of the wing, though after continued as one of the general thin lines to the dorsal apical edge. The third line is midway between the fold and the costal edge and begins at the middle of the wing and reaches to the end of the cell; also continued as one of the fainter lines from base to apex.

Cilia gray. Hindwings as broad as forewings, yellowish fuscous; cilia yellowish. Abdomen light yellowish brown. Legs yellowish without any markings.

Variety a.—The three prominent longitudinal black streaks are intact, but the other longitudinal lines are nearly or quite obsolete. The color of the forewings below the three black lines is dark chocolate brown, the color above the lines whitish purple, the two colors standing sharply against each other, separated by the black lines.

The color of head and thorax is correspondingly dark brown.

Variety b.—Ground color of forewings more whitish, thickly suffused with dark brown and gray single scales. The three heavy black longitudinal streaks are present, but with a tendency to break up in shorter streaks or totally disappear, especially the first and the third, which are represented as one, two, or three longitudinal dots.

The other longitudinal lines are obsolete, except right around apex, where they are indicated by a series of short indistinct streaks at base of the cilia.

Besides these two extreme varieties all intermediate forms occur between them and what I call the normal form. While single specimens of the extreme varieties might easily be taken for different species and while absolute proof to the opposite can not be obtained except through breeding, I have no doubt but that they all belong to one variable species.

Alar expanse.—19 to 20 mm.

Habitat.—California, Colorado.

Type.—No. 6385, U. S. N. M.

Described from some 20 specimens of all varieties in the U. S. National Museum; many others have been examined in the collections of Messrs. Dietz, Kearfott, and Gillette.

GELECHIA TRILINEELLA Chambers.

Gelechia trilineella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 125; IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5499, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5742, 1903.

In the Museum of Comparative Zoology in Cambridge I found six types of this species, authenticated by Chambers' labels and agreeing with his description. They are all, however, much faded. A fresh specimen in U. S. National Museum, which I have compared with the types, exhibits the detail of the description better. Similar good specimens I have examined in Dr. Dietz's collection, determined independently by him from the description.

Habitat.—Colorado, Arizona.

GELECHIA BIANULELLA Chambers.

Oescis bianulella CHAMBERS, Cinn. Quart. Journ. Sci., 1875, p. 225; Bull. U. S. Geol. Surv., IV, p. 159; Journ. Cinn. Soc. Nat. Hist., II, 1880, p. 202, fig. 15.—RILEY, Smith's List Lep. Bor. Am., No. 5579, 1891.

Gelechia bianulella BUSCK, Dyar's List Amer. Lep., No. 5743, 1903.

Gelechia? ocellella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 126.

Gelechia ocellella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5428, 1891.

I have examined type of *Gelechia ocellella* in Professor Fernald's collection and types of the same in Cambridge Museum; they are identical and agree with his description.

The synonymy with *Oescis bianulella* I did not discover before I saw in Dr. Dietz's collection a specimen labeled by Lord Walsingham *Oescis bianulella*. No authentic specimen from Chambers of this species exists, but I have no doubt that the specimen is rightly named by Lord Walsingham, as it faithfully agrees with Chambers' description, and if so it is the same as *Gelechia ocellella*. The description of the two species are nearly identical and could well both have been drawn from the same specimen.

GELECHIA DISCOOCELLELLA Chambers.

Gelechia discoocellella CHAMBERS, Can. Ent., IV, 1872, p. 194.—BUSCK, Dyar's List Amer. Lep., No. 5744, 1903.

Gelechia discoocellella CHAMBERS, Can. Ent., VI, 1874, p. 231.

Gelechia discoocella CHAMBERS, Cinn. Quart. Journ. Sci., 1875, II, p. 237; Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5355, 1891.

Gelechia discoocella COQUILLET, Papilio, III, 1883, p. 98.

Gelechia discoocella DIETZ, Smith's List Ins. N. Jersey, 1900, p. 474.

Gelechia violaceofusca ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 258.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 148.—RILEY, Smith's List Lep. Bor. Am., No. 5510, 1891.

Zeller omitted to mention in his description of *violaceofusca* the ocellate spot at the end of the cell, which, though very indistinct in some lights, is plainly found in his unique well-preserved type in the Cambridge Museum. This type is a male and the spot is not nearly so prominent in this sex as in the females.

It is clearly the same species as represented by Chambers' four types of *discoocellella* also found in the Cambridge Museum and answering to his description of that species.

Chambers' name has precedence.

The ocellate spot at the end of the cell, as well as the lighter streak below the fold, are, as Chambers observed, somewhat variable, and especially in the males, indistinct; but the glossy violet sheen and the abruptly cut forewings makes this species easily recognized.

In the U. S. National Museum and in the collections of Professor Fernald and Dr. Dietz are specimens determined by Lord Walsingham as *Gelechia (Trichotaphe) discoocellella*. The species has, it is true, some general resemblance to the genus *Trichotaphe*, but palpi and venation place it in *Gelechia*.

Mr. Coquillet has given its food plant as *Polygonum*. This agrees with a note from Miss Murtfeld that she reared the types from *smart-weed*, *Polygonum hydropiperoides*, not, as Chambers wrote,¹ "small weed."

This species has a noteworthy color resemblance with another polygonum-feeding Tineid, *Aristotelia absconditella* Walker (p. 801).

It has a wide distribution; Chambers recorded it from Kentucky and Texas; Zeller from Texas; Coquillet from Illinois; in U. S. National Museum are specimens from Kansas (Crevecoeur), Illinois (Barnes), Pennsylvania (Dietz), District of Columbia (Busck).

GELECHIA ANARSIELLA Chambers.

Gelechia anarsiella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 126.—RILEY, Smith's List Lep. Bor. Am., No. 5310, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5745, 1903.

¹ Cinn. Quart. Journ. Sci., II, 1875, p. 237.

On the label of the type of this species in the Museum of Comparative Zoology in Cambridge is a note in Frey's handwriting:

After the palpi it is an *Ypsolophus*.—Frey.

It is true that the brush on second joint of labial palpi is strongly developed, but not in the long projecting pointed fashion found in *Ypsolophus*; it is a large divided spreading brush, just like that found in *Gelechia* (*Oeseis*) *bianutella* Chambers, and I do not consider it of generic value, but merely the extreme development of the brush as commonly found in *Gelechia*, with which genus *amarsiella* also agrees in venation and general habitus.

In U. S. National Museum is an identical specimen labeled by Chambers; there is also a fine specimen bred by Dr. Harrison G. Dyar from *Ceanothus* in Colorado.

According to Dr. Dyar, the larva hides in a silken tube in a folded leaf, or between leaves.¹

GELECHIA PRAVINOMINELLA Chambers.

Gelechia quadrinaculella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 290; Bull. U. S. Geol. Surv., III, 1877, p. 128.

Gelechia pravinominella CHAMBERS, Can. Ent., X, 1878, p. 50; Bull. U. S. Geol. Surv., IV, 1878, p. 146; RILEY, Smith's List Lep. Bor. Am., No. 5451, 1891; BUSCK, Dyar's List Amer. Lep., No. 5746, 1903.

Not *Gelechia quadrinaculella* CHAMBERS, Can. Ent., VI, 1874, p. 237 (see *Aucampsis rhoifrutella*, p. 845).

As this species, the type of which is lost, I have identified a specimen which agrees with Chambers' short description and which was taken in the same locality from where Chambers' type came.

It was bred by Dr. Dyar from cottonwood in Colorado.¹

GELECHIA BARNESIELLA, new species.

Gelechia barnesiella BUSCK, Dyar's List Amer. Lep., No. 5747, 1903.

Antennae simple dark fuscous. Labial palpi very long, slender; brush on second joint short and even; second joint whitish, sometimes with a rose tint, sprinkled with brown; terminal joint long, but shorter than the very long second joint, thin, pointed, whitish, sprinkled with black and dark brown. Head brown, loosely scaled, nearly tufted, and with a peculiar strong pointed horny frontal protuberance. Face somewhat lighter.

Forewings brown, of a somewhat variable shade in different specimens, from a reddish or deep purple brown to a lighter ashy or yellowish brown. At base of costa is a dark blackish spot, sometimes continued into an obscure oblique streak across the wing. On the middle of the disk is a short oblique blackish streak, and just below this another similar but fainter streak, together forming an arrow-

¹ Described by Dr. Dyar, Proc. U. S. Nat. Mus., XXV, 1902, p. 407.

head pointing toward the tip of the wing. At the end of the disk is a short perpendicular blackish streak edged with light scales. A little before apical third is a large, dark, ill-defined costal spot; on apposite on the dorsal edge is another similar spot. Around apical edge is a series of blackish spots, with the intervening spaces rather lighter than the general color of the wing.

Hindwings as broad as forewings, light silvery fuscous. Abdomen light yellowish brown. Legs whitish fuscous speckled with darker brown, each joint of tarsi tipped with white.

Alar expanse.—22 to 27 mm.

Habitat.—Colorado.

Type.—No. 6386, U.S.N.M.

Described from some thirty specimens collected by Dr. W. Barnes, in honor of whom the species is named, and by Messrs. Gillette and Schwarz.

The ornamentation is sometimes not very distinct, and the ground color shows some variation in shade, but the species is quite different from any described and easily recognized by its size, the very long evenly brushed palpi, and especially by the peculiar frontal horn, which is found both in the males and females. It is found also in a less marked degree in *Gelechia variabilis* Busek (p. 871).

GELECHIA LINDENELLA, new species.

Gelechia lindenella Busek, Dyar's List Amer. Lep., No. 5748, 1903.

Antennae light yellow, black at base and indistinctly annulated with dark fuscous. Labial palpi with brush short and even; terminal joint as long as second; ocherous white, sprinkled with black scales; tip of terminal joint black. Face white; head and thorax light ocherous. Forewings light ocherous, sprinkled with darker ocherous and black scales, especially along dorsal edge and toward apex, where the dark scales are arranged in indistinct longitudinal streaks between the veins. There are three black or very dark brown equidistant costal spots, one near the base, one at apical third, and one between these two. The one nearest base is the smallest, the next somewhat larger, and the outermost the largest. Just below this last is, at the end of the disk, an inconspicuous short and thin perpendicular line. On the middle of the wing is an inconspicuous dark brown dot, and just below on the fold is a similar dot. Around the apical edge is an indistinct row of small diffused blackish dots at base of cilia. Hindwings fully as wide as forewings, yellowish white. Abdomen ocherous fuscous. Legs ocherous, sprinkled with black. Tarsi black with each joint tipped with yellow.

Alar expanse.—13 to 17 mm.

Habitat.—Texas, Colorado, Arizona.

Type.—No. 6387, U.S.N.M.

Described from many Texan specimens, from Mr. William Beutenmüller's collection, and from specimens collected by Messrs. E. A. Schwarz and H. S. Barber in Colorado and Arizona.

It is a very distinct species, recognized by the pale color and the three black costal spots. The ornamentation recalls *Epithectis bicostomaculella* Chambers [p. 817.]

GELECHIA DYARIELLA, new species.

Gelechia dyariella Busck, Dyar's List Amer. Lep., No. 5749, 1903.

Antennæ whitish fuscous, indistinctly annulated with darker fuscous. Labial palpi with normal well-developed brush; terminal joint shorter than second; whitish suffused with bluish black scales on the outside; brush and terminal joint nearly black. Face white with a few light fuscous scales. Ground color of head, thorax, and forewings whitish, but so heavily overlaid with dark fuscous and bluish black scales as to give the appearance to the naked eye of dark gray. At the base is an oblique, ill-defined, obscure, blackish streak; on the middle of the wing is a black oval dot followed by a short space of pure white; at apical third is a large transverse blackish area across the wing, edged on the outside by a narrow zigzag white fascia. Hindwings as broad as forewings, light silvery fuscous, darker toward apex; cilia yellowish fuscous. Abdomen silvery gray; first segments velvety yellow on upper side; under side white. Legs white, profusely sprinkled with bluish black scales.

Alar expanse.—14 to 18 mm.

Food plant.—Cottonwood.

Habitat.—Colorado.

Type.—No. 6388, U.S.N.M.

An obscurely marked species near the following, *Gelechia albisparsella*. Described from a large series bred by Dr. Dyar, who has given me the following notes on the larva:

Larva.—Resembling the larva of *Nycteola (Sarothripa)*. Slender, thorax and joint 13 smaller than the other segments, submoniliform; head whitish testaceous, darker in the sutures and vertex, ocelli black. Body all rather opaque soft green, the incisures folded, dorsal vessel dark green, male glands whitish, small. Cervical shield like the body, but more shining and luteous tinted; feet normal, pale; joint 13 dorsally dark punctate. Tubercles ia and ib separate, iia+iiib, iv+v, the latter on both thorax and abdomen.

On cottonwood, Denver, Colorado. Folding up a young leaf by uniting the edges around the margin so that it forms a bag or box; solitary. The larvæ turned pink on leaving the bags to spin. Imago July 3.

GELECHIA ALBISPARSELLA Chambers.

Depressaria albisparsella CHAMBERS, Can. Ent., IV, 1872, p. 92 and p. 128.

Cirrho platanella CHAMBERS, Can. Ent., IV, 1872, p. 146; Bull. U. S. Geol. Surv., IV, 1878, pp. 118, 146.—RILEY, Smith's List Lep. Bor. Am., No. 5285, 1891.

Gelechia albisparsella BUSCK, Dyar's List Amer. Lep., No. 5750, 1903.

Two undoubtedly authentic types of this species labeled by Chambers, *Cirrho platanella*, are found in the Museum of Comparative Zoology in Cambridge and prove that the genus *Cirrho*, which can hardly be said to have been characterized by Chambers' few lines of general remarks, is synonymous with *Gelechia*. Chambers changed his specific name when he discovered the food plant, which was not admissible, and the species must be known under its original specific name.

Food plant.—*Plantanus occidentalis*.

Habitat.—Kentucky.

GELECHIA UNCTULELLA Zeller.

Gelechia unctulella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien., XXIII, 1873, p. 257.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5503, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5751, 1903.

The unique type in good condition is in Cambridge Museum. Zeller mentions only two black dots, one on the disk and one at the end of the disk, and says: "Andere Zeichnungen fehlen." These two spots are the most prominent and the only ones seen in certain lights against the nearly black general color of the wing, but as a matter of fact there is, as type also shows, three other smaller black spots on the fold and one more on the disk. All of the spots, however, are quite indistinct.

In the U. S. National Museum is a very large bred series of this species from Colorado and Arizona, bred respectively by Dr. H. G. Dyar and Mr. E. A. Schwarz from *Thermopsis* and from *Robinia*.

Dr. Dyar has published his notes on the larva.¹

According to Mr. Schwarz, this species is at some places so abundant as to do actual damage, spinning up every leaflet of the *Robinia*.

GELECHIA OBSCUROOCELELLA Chambers.

Gelechia obscuerocelella CHAMBERS, Cin. Quart. Journ. Sci., II, 1875, p. 254; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5424, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5752, 1903.

Type of this species is lost, and no authentic specimen is found, but I have with little hesitation determined from description as this species a specimen from San Antonio, Texas, collected in May, which in every respect agrees with Chambers' description, and which, I have no doubt, truly represents this species.

GELECHIA VERSUTELLA Zeller.

Gelechia versutella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien., XXIII, 1873, p. 253.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 148.—BUSCK, Dyar's List Amer. Lep., No. 5753, 1903.

¹Proc. U. S. Nat. Mus., XXV, 1902, p. 407.

The unique type of this species is found in the Cambridge Museum in excellent condition. A good bred series in the U. S. National Museum carefully compared with the type bears the designation "U. S. Dept. of Agriculture Insectary, Nos. 4232 and 5786," and the corresponding records show that it has been bred twice, first from larva skeletonizing leaves of cottonwood, received from El Paso, Texas, in November, 1887, from which the moths issued in January next year. The note on the larva is very short:

Greenish white, with a pink blush on dorsal surface.

Secondly, it was received in July, 1893, from Jetsam, Wyoming, with the report that the larvæ were extremely injurious to cottonwood. With this is the following note on the larva:

Head pale brown, with posterior margin black; body pale yellowish white without any markings. The moths issued July 3 to 8.

The Texan specimens average a little lighter and smaller than those from Wyoming, but they are undoubtedly same species. The type, although from Texas, agrees with the darker Wyoming specimens. Finally, there is in the National Museum one specimen of this species, bred by Dr. Dyar from cottonwood in Colorado.

This species is extremely similar to the following in ornamentation and easily mixed with it. The palpi, however, give a good distinguishing character. In the present species the brush is normal and well developed, longer at base than at apex of second joint, while *Gelechia lynceella* has a very short and even brush. The palpi also show color differences as pointed out by Zeller.

GELECHIA LYNCEELLA Zeller.

Gelechia lynceella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 255.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5403, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5754, 1903.

Type is found in good condition in the Cambridge Museum. I have met with no other specimen. Very similar to the foregoing.

Habitat.—Texas.

GELECHIA BICOSTOMACULELLA Chambers.

Depressaria bicostomaculella CHAMBERS, Can. Ent., IV, 1872, pp. 127, 147; Bull. U. S. Geol. Surv., IV, 1878, p. 138.

Adrasteia quercifoliella CHAMBERS, Can. Ent., IV, 1872, p. 206; V, 1873, p. 174.

Gelechia quercifoliella, CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5461, 1891.

Psoricoptera gibbosella CHAMBERS (not Stainton), Can. Ent., V, 1873, p. 72.

Gelechia bicostomaculella DIETZ, Smith's List Ins. N. Jersey, 1900, p. 474.—BUSCK, Dyar's List Amer. Lep., No. 5755 1903.

Not *Gelechia bicostomaculella* CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 127; IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5322, 1891.

The second species which Chambers described as *Gelechia bicostomaculella* from Colorado is an *Epitactis* and is treated on p. 817 under that genus.

Of the present species no authentic type is in existence, but in the U. S. National Museum are two specimens determined by Lord Walsingham, and similar specimens in the collection of Dr. Dietz and Professor Fernald, also determined as *bicostomaculella* by Lord Walsingham. Some of these specimens are bred by Miss Murtfeldt from oak, and bear her breeding number 174 M. Miss Murtfeldt thinks this the true *bicostomaculella*, and as it agrees with Chambers' description it seems altogether probable that this truly is that species.

The species is near the following and *Gelechia vernella* Murtfeldt, but has raised scales on the forewings, in which character, as well as in the stalked veins 6 and 7 in the hindwings and the slightly parted veins 3 and 4 it approaches the genus *Telphusa*.

GELECHIA NIGRIMACULELLA, new species.

Gelechia nigrimaculella RILEY, Smith's List Lep. Bor. Am., No. 5418, 1891.—
BUSCK, Dyar's List Amer. Lep., No. 5756, 1903.

In Riley's List of Tineina is found, under no. 5418, the name *Gelechia nigrimaculella* Chambers, and in U. S. National Museum is a large apparently bred series labeled with this same name. But no description has ever been printed of the insect, which I now describe under the old manuscript name given by Chambers.

Antennæ dark fuscous. Labial palpi with normal well-developed brush; ocherous strongly suffused with black except tips of second and third joint, which are clear ocherous. Face, head, and thorax brownish sprinkled with fuscous and blackish scales. Ground color of forewings whitish fuscous but obscured by a liberal sprinkling of dark-brown and black scales. An ill-defined longitudinal streak below costal edge is whitish; costal edge nearly black; on the middle of the disk is an oblique short black dash, and just below this a similar one. At apical third is an obscure outwardly angulated narrow white fascia, and just before this is a costal and a dorsal blackish spot nearly reaching each other. Cilia whitish.

Hindwing as broad as forewings, light fuscous, darker toward tip. Abdomen yellowish fuscous above, below white. Legs whitish sprinkled with black; tarsal joints black tipped with white.

Alar expanse.—13 to 15 mm.

Habitat.—New York, New Jersey.

Type.—No. 6389 U.S.N.M.

Very close to the Californian *Gelechia occidentella* Chambers, but differing by its dark face. Described from many specimens collected by Mr. William Beutenmüller, and found in U. S. National Museum labeled "*Gelechia nigrimaculella* Chambers."

GELECHIA MACULIMARGINELLA Chambers.

Gelechia maculimarginella CHAMBERS, Can. Ent., VI, 1874, p. 241.—BUSCK, Dyar's List Amer. Lep., No. 5757, 1903.

Gelechia maculomarginella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5405, 1891.

Authentic types of this species are found in Professor Fernald's collection and in the Cambridge Museum; the latter are in miserable condition, but agree with Professor Fernald's type as far as can be made out and with Chambers' descriptions. I have bred large series of this species in the District of Columbia and vicinity. The larva feeds on different kinds of oak, and there are at least two generations in this locality. The larva is among the earliest found in the spring (April) in the half-developed unfolded leaves or buds.

The imago of this brood is in the middle of May. In June there is a second brood feeding between two spun-together leaves; imagoes issue in the latter part of July.

Very probably there is a third autumn brood, which either overwinters and lay eggs in early spring, in the swelling leaf buds, or which lay their eggs on the bud, all ready in the autumn.

The easily recognized larva is slender and very agile. Head and thoracic plate polished jet black; first and second thoracic segments deep purple, third, lighter purple with anterior half white. Abdominal segments whitish with four (two on each side) longitudinal purple lines connected on each joint by a broad purple band, which sends two small dorsal projections forward into the white part on each joint.

Thoracic feet and anal plate black; length of full-grown larva 14 mm.; width of head 0.9 mm.

This species as well as *Gelechia vernella* and *Gelechia bicostomaculella* have the hairs on vein 1b in the hindwings of the male strongly developed, resembling a tuft or pencil of long blackish hairs.

GELECHIA BIMINIMACULELLA Chambers.

Gelechia biminimaculella CHAMBERS, Cinn. Journ. Nat. Hist., II, 1880, p. 183.—RILEY, Smith's List Lep. Bor. Am., No. 5327, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5758, 1903.

The type in Cambridge Museum of this species, with Chambers' label on the pin and agreeing with his description, was found to be identical with a series in U. S. National Museum bred from oak in Missouri by Miss Murtfeldt, and determined by her as this species. I have not met with other specimens.

GELECHIA PSEUDOACACIELLA Chambers.

Depressaria pseudoacaciella CHAMBERS, Can. Ent., IV, 1872, pp. 9, 107, 129, 147, 148.
Gelechia pseudoacaciella CHAMBERS, Cinn. Quart. Journ. Sci., I, 1874, p. 208; Geol. Surv. Bull. U. S., IV, 1878, p. 146; Psyche, III, 1880, p. 65.—RILEY, Smith's List Lep. Bor. Am., No. 5453, 1891.

Gelechia cæcella ZELLER, Verh. k. k. zool.-bot. Gesell., Wien, XXIII, 1873, p. 252.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5331, 1891.

Of this very common insect, the larva of which was shortly described by Chambers, there is a large series in U. S. National Museum, among which are specimens determined by Chambers and by Lord Walsingham. I have repeatedly bred it from *Robinia pseudacacia* around Washington, and I have seen it from most of the Eastern States.

The specimens, which Riley bred from wild cherry, and which Chambers could not distinguish from *pseudocaciella*,¹ are still in U. S. National Museum and belong to another perfectly distinct though quite similar species, described in this paper as *Gelechia serotinella*.

I am indebted to Lord Walsingham for the synonymy of Zeller's *Gelechia cæcella*, type of which is in his possession and which he has given me his manuscript notes on.

The description fully bears out this synonymy.

GELECHIA SEROTINELLA, new species.

Gelechia serotinella BUSCK, Dyar's List Amer. Lep., No. 5760, 1902.

Gelechia pseudoacaciella CHAMBERS, Psyche, III, 1880, p. 65.

Antennæ shining purplish black, with very narrow white indistinct annulations; labial palpi with second joint above whitish, strongly sprinkled with black scales; under side of the well-developed brush black; terminal joint black, with extreme tip and a few scattered scales white.

Face whitish, overlaid with dark purple. Head and thorax clothed with mixed white and purplish black scales, the latter predominating; forewings dark, black and white scales irregularly mixed, but the black prevailing; in a narrow longitudinal streak along but below costal edge dark-brown scales are also freely intermixed, giving that part of the wing a perceptible chocolate-brown shade. At the end of this streak at apical fourth the white scales congregate in an ill-defined costal white spot, which is connected with an opposite equally ill-defined dorsal white spot by a wavering interrupted narrow white fascia. Cilia dark fuscous, intermixed with white and with two faint blackish lines parallel with the edge of the wing.

Hindwings as broad as forewings, dark shining fuscous; cilia, light fuscous; abdomen above on the first segments velvety yellowish brown; the other segments and under side very dark shining fuscous; legs with white and dark purple scales intermixed; posterior tibia on the outside black, with two white bars, on the inside silvery white; tarsal joints black, tipped with white.

Alar expanse.—16 to 21 mm.

Food plant.—*Prunus serotina*.

¹ Psyche, III, 1880, p. 65.

Habitat.—District of Columbia; Colorado.

Type.—No. 6390, U.S.N.M.

The species is very near the foregoing, *pseudocaciella*, and it was very natural that Chambers, from the imago alone, should identify it as that species; but it is a larger and darker insect, without the whitish costal area found in *pseudocaciella*.

The egg of this species is laid on the upper side at the tip of a leaf of wild cherry. The young larva spins together the edges of the leaf, and as it grows it folds gradually the entire leaf into a roomy abode, the open end of which it covers with a glistening white, thickly woven sheet of silk. In this cell the larva lives in a black tube made from its own frass and spun firm by silk, and it feeds under the protecting sheet of silk, which is gradually enlarged and moved outward as new feeding ground is needed. The larva is very timid and retreats at the least disturbance into its tube of frass, which it, when full grown, forms into an oval cocoon, in which it pupates. The imago issues within the cell and breaks through the sheet of silk.

The larva is very similar to that of *pseudocaciella*. When young it has a black head and thoracic shield, body dirty greenish white, darkest on the under side, and with two narrow longitudinal dark-brown dorsal lines and four (two on each side) broader lateral lines through all the segments.

When full grown the larva measures 20–24 mm. in length, with head 1.6 mm. broad. Head and thoracic shield is then light brown, the ground color of the body more nearly white, and the stripes more reddish.

Dr. Dyar, who has bred this insect from larva with identical habits in Colorado, has kindly given me the following technical description of the larva:

Head broad, red-brown, sutures and ocellar area blackish. Body purple brown with white stripes, narrower than the intervening spaces; irregular dorsal line, subdorsal (over tubercles i and ii), lateral (over iii), and broken, broad, distinct, subventral (over iv + v and vi). Feet brownish; cervical shield black behind and shading to sordid white before, rather transparent on anterior rim; prespiracular tubercle black. Tubercles small, brown. Thoracic feet black; anal plate luteous; setae fine and pale; abdominal feet reddish, those of joint 13 partly pale.

In the locality of Washington there are two annual generations. The young larvæ are first found in May, and in early June they are full grown and already pupated. Imagoes issue late in July and early in August, and lay their eggs soon after, producing the second generation, which overwinters as full-grown larva in its cocoon and issues as imago next spring.

The peculiar life mode of the larva and its elaborate architecture reminded me at once, when I found it two years ago, of Clemens' description of his genus *Catastega*, which was founded solely on the

habit of the larva. As Dr. Dyar has since shown,¹ this genus must be included in the Tortricidæ, and has nothing to do with the present species; but the life mode is identical with that described by Clemens, and illustrates how dangerous it is to rely on earlier stages alone in making new specific and generic groups.

GELECHIA VERNELLA Murtfeldt.

Gelechia formosella MURTFELDT (not Hübner), Can. Ent., XIII, 1881, p. 243.—RILEY, Smith's List Lep. Bor. Am., No. 5364, 1891.

Gelechia vernella MURTFELDT, Can. Ent., XV, 1883, p. 139.—RILEY, Smith's List Lep. Bor. Am., No. 5508, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5761, 1903.

Cotypes of this species are in U. S. National Museum, and I have obtained additional material through the kindness of Miss Mary Murtfeldt.

Food plant.—Oak.

Habitat.—Missouri.

I have not recognized this species from other localities.

GELECHIA SEQUAX Haworth.

Recarvaria sequax HAWORTH, Lepidoptera Brit., 1829, p. 552.

Gelechia (Teleia) sequax STAUDINGER and REBEL, Cat. Lep. Eur., II, No. 2741, 1901.—ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 265.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5478, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5762, 1903.

This European species was included in the American list, on Zeller's authority, from Massachusetts.

I have not met with any specimen from America, and it seems probable that some mistake was made in the labeling of Zeller's specimen or in his determination.

In the U. S. National Museum is a good series of European specimens.

The larva lives, according to Meyrick, in spun shoots of *Helianthemum*.

GELECHIA OCCIDENTELLA Chambers.

Gelechia occidentella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 246; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5427, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5763, 1903.

In the Museum of Comparative Zoology, in Cambridge, are found three probably authentic types of this species. They are true *Gelechia* and can be recognized also specifically, although they are in poor condition and have lost their palpi. I have met with no specimens exactly like them.

Habitat.—California.

¹See p. 852.

GELECHIA MEDIOFUSCELLA Clemens.

Gelechia mediofuscella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, pp. 11, 121; Stainton Ed. N. Am. Tin., 1872, pp. 218, 224.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5407, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5764, 1905.

Gelechia vagella WALKER, Cat. Lep. Het. Brit. Mus., XXIX, 1864, p. 596.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 178.—RILEY, Smith's List Lep. Bor. Am., No. 5506, 1891.

Depressaria fuscoochrella CHAMBERS, Can. Ent., IV, 1872, pp. 106, 129, 147, 148.

Gelechia fuscoochrella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.

Gelechia (Lita) lituosella ZELLER, Verk. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 265.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.

To Lord Walsingham is due the credit for the entire synonymy. I am indebted to him for his manuscript note that *mediofuscella* should be added to the already published synonymy, which the description also bears out.

It is a common species in the District of Columbia, which I have taken in numbers in very early spring (March, April), and again in July.

Its life history is unknown as yet, but a clew may be found in a specimen which issued, April 25, from old, dry cornstalks collected and placed in breeding case the previous fall. This specimen was perfect and seemingly fresh, but not having observed the larva, I am unable to say with certainty that it was not an overwintering moth or that the larva accidentally had found a convenient pupating place in the cornstalks.

GELECHIA WALSINGHAMI Dietz.

Pseudochelaria walsinghami DIETZ, Ent. News, XI, 1900, p. 352, pl. 1, fig. 3.

Gelechia walsinghami WALSINGHAM and DURRANT, Ent. Mo. Mag., XXXVIII, 1902, p. 28.—BUSCK, Dyar's List Amer. Lep., No. 5765, 1903.

Through the kindness of Dr. Dietz I have examined his types of this species and the National Museum possesses several cotypes. It is a typical *Gelechia*, which was placed by error in an unpublished manuscript genus of Lord Walsingham's, thereby spoiling the name *Pseudochelaria* for future application to the intended—to me unknown—genus.

Food plant.—*Rhus typhosa*.

Habitat.—Pennsylvania.

GELECHIA PENNSYLVANICA Dietz.

Pseudochelaria pennsylvanica DIETZ, Ent. News, XI, 1900, p. 353, pl. 1, fig. 4.—WALSINGHAM, Ent. Mo. Mag., XXXVIII, 1901, p. 29.

Gelechia pennsylvanica BUSCK, Dyar's List Amer. Lep., No. 5766, 1903.

As this species must be credited to Dr. Dietz it was proper that he

should describe it, and he has kindly handed me the following description of the moth which he figured.¹

Ashen gray, palpi with third joint longer than second, latter dark brownish at base externally, former dusted with fuscous, base and extreme apex white. Antennae faintly annulate with fuscous. Thorax with dark-brown spot posteriorly. Forewings marked with dark rich brown as follows: A trapezoidal space at base sharply limited externally by an oblique line nearer the base at the dorsal margin and slightly concave toward the apex. This space is separated from the costal margin by a pale area. An irregular stripe extends through the entire wing to apex, shading off gradually toward the costa. A transverse pale line at the beginning of the cilia, oblique in its dorsal half, concave toward the apex in its costal part. Apical part of wing with dark lines. Cilia gray with two dark lines. Posterior wings pale fuscous. Underside paler. Legs, except posterior pair, fuscous, annulated with black.

Alar expanse.—17 mm.

Habitat.—Hazleton, Pennsylvania.

Type.—In Dietz's collection.

Described from a single specimen taken at light. Closely allied to *Gelechia walsinghami* Dietz.

I have seen no other specimen of this species which, in my judgment, is a true *Gelechia*, and not what it was supposed to be, the type of *Pseudochalaria* Walsingham manuscript.

GELECHIA TEPHRIASELLA Chambers.

Gelechia tephriasella CHAMBERS, Can. Ent., IV, 1872, p. 68; Cinn. Quart. Journ. Sci., II, 1875, p. 253; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 181.—RILEY, Smith's List Lep. Bor. Am., No. 5490, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5767, 1903.

No authentic type of this species exists, but in the U. S. National Museum is a specimen which has on the pin one of Chambers' pill-box labels with *Gelechia tephriasella* in his handwriting. This specimen consists of only thorax and the two forewings, but these latter agree with Chambers' description and the specimen presumably truly represents this species.

While the genus can not be determined with certainty from these two forewings, the species appears to belong near the following, a probability which is strengthened by Chambers' description and his observation² that this species reminded him of *grissefasciella* (*conclusella* Walker).

However, the generic determination must stand only for what it is, liable to change through future evidence.

The venation in the forewings is normal 12 veins, 7 and 8 stalked, rest separate (not as in the following with veins 3 and 4 stalked). The peculiar coloration of the antennae described by Chambers should make recognition of this species easy.

Habitat.—Kentucky.

¹Ent. News, XI, pl. 1, fig. 4.

²Cinn. Quart. Journ., II, p. 253.

GELECHIA CONCLUSSELLA Walker.

Gelechia conclusella WALKER, Cat. Lep. Het. Brit. Mus., XXIX, 1864, p. 593.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 179.—RILEY, Smith's List Lep. Bor. Am., No. 5341, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5768, 1903.

Gelechia grissefasciella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 253; Bull. U. S. Geol. Surv. IV, 1878, p. 144.

In the U. S. National Museum are several specimens labeled by Lord Walsingham, *Gelechia conclusella* Walker; these are identical with specimens thus named by Lord Walsingham in collections of Dr. Dietz, and in the Philadelphia Academy of Natural Sciences. They agree with Walker's description and evidently correctly represent his species.

They are the same as type no. 447, in the U. S. National Museum, of *Gelechia grissefasciella*, received with his label from Chambers, thus confirming the synonymy made by Walsingham. There is one other supposed "type" of *grissefasciella*, namely, in the Museum of Comparative Zoology, Cambridge, but this is an entirely different thing, an undescribed species of *Nalyda*, unhappily unfit for description; it does not, however, agree with Chambers' description, while U. S. National Museum type does, and the latter is evidently authentic.

Lord Walsingham also made *cresecentifasciella* Chambers a synonym of *conclusella*, but this, as previously shown (p. 846), was done on faulty evidence, and *cresecentifasciella* is a distinct species belonging to *Anacamptis*.

The present species has veins 3 and 4 in forewings stalked, and thereby differs from the most of the species in the genus in which it is placed. I am, however, at present not willing to differentiate it generically.

GELECHIA RILEYELLA Chambers.

Depressaria rileyella CHAMBERS, Can. Ent., IV, 1872, pp. 106, 129, 147, 148; Bull. U. S. Geol. Surv., IV, 1878, p. 138.—RILEY, Smith's List Lep. Bor. Am., No. 5277, 1891.

Gelechia rileyella RILEY, Smith's List Lep. Bor. Am., No. 5468.—BUSCK, Proc. U. S. Nat. Mus., XXIV, 1902, p. 732; Dyar's List Amer. Lep., No. 5769, 1903.

Type no. 462, in the U. S. National Museum, of *Depressaria rileyella*, bearing Chambers' handwritten label and the date 1872, is the same as three types found in the Museum of Comparative Zoology in Cambridge, also bearing Chambers' labels.

These types are all in very poor condition specifically, but prove conclusively that the species is a true *Gelechia*.

The type in the National Museum bears Lord Walsingham's blue label no. 1170, and there is also a better preserved specimen determined by Walsingham and bearing his blue label no. 1211.

Habitat.—Kentucky, Canada.

No other specimens are known to me.

GELECHIA NUNDINELLA Zeller.

Gelechia nundinella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 256.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5420, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5770, 1903.

Gelechia beneficientella MURTFELDT, Can. Ent., XIII, 1881, p. 245.—RILEY, Smith's List Lep. Bor. Am., No. 5321, 1891.

Zeller's type in the Cambridge Museum of *Gelechia nundinella* proves, as the description would indicate, that it is the same as Miss Murtfeldt's later-described *beneficientella*, of which good bred series are found in the U. S. National Museum, besides authentic specimen received from Miss Murtfeldt.

Food plant.—*Solanum carolinense*.

Habitat.—Missouri (Murtfeldt), Texas (Zeller, Boll), District of Columbia (Busck).

GELECHIA MONUMENTELLA Chambers.

Gelechia monumentella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 125; U. S. Geol. Surv. Bull., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5413, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5771, 1903.

The unique type of this species is found in good condition in the Cambridge Museum, agreeing with the description, and labeled "Colorado," with the name in Chambers' handwriting.

The type shows one point not mentioned by Chambers, namely, a thin, indistinct, but complete white fascia at apical third.

In the U. S. National Museum there is a large series of this very distinct insect, bred by Mr. Coquillett and Mr. Koebele in California from *Fraxinea grandiflora*.

GELECHIA OBSCUROSUFFUSELLA Chambers.

Gelechia obscurossuffusella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 90, 145.—RILEY, Smith's List Lep. Bor. Am., No. 5425, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5772, 1903.

Type no. 456, in the U. S. National Museum, of this species from Chambers agrees with other types examined in the Cambridge Museum and in Professor Fernald's collection. All are in rather poor condition, but agree so far as can be made out with Chambers' description and prove that the species is a true *Gelechia*.

I have met with no other specimens.

Habitat.—Texas.

GELECHIA PETASITIS Pfaffenzeller.

Gelechia petasitis PFAFFENZELLER, Stett. Ent. Zeit., XXVIII, 1867, p. 79.—STAUDINGER and REBEL, Cat. Lep. Eur., II, 1901, No. 2588.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 178.—RILEY, Smith's List Lep. Bor. Am., No. 5445, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5773, 1903.

I have examined in Professor Fernald's collection three specimens which Lord Walsingham determined as the European insect.

One of these, through the kindness of Professor Fernald, is now the property of U. S. National Museum. It agrees with Pfaffenzeller's description.

The European food plant is *Petasitis niveus*, on which the larva mines the leaves. Other species of *Petasitis*, on which the species may live, occur in this country.

GELECHIA PANELLA, new species.

Gelechia panella Busck, Dyar's List Amer. Lep., No. 5774, 1903.

Antennæ dark reddish fuscous, annulated with white. Labial palpi with well developed furrowed brush; second joint on the upper and inner side whitish, the outside and the brush deep purplish red. Face white with a reddish tint. Head, thorax, and forewings uniformly bright brick red; at the end of the cell is a very indistinct blackish dot and at apical third is a still more indistinct very narrow oblique yellowish white fascia across the wing. No other markings are found, and those mentioned are easily overlooked. Cilia reddish, sprinkled with white. Under side of forewings shining dark fuscous. Hindwings broader than forewings, light silvery fuscous, darker and yellowish toward apex. Cilia yellowish fuscous. Abdomen dark fuscous, underside ochreous. Forelegs reddish, posterior legs yellow sprinkled with black; tarsal joints blackish, slightly tipped with yellow.

Alar expanse.—20 mm.

Habitat.—Arizona, California.

Type.—No. 6391, U.S.N.M.

This striking species, which can not be confused with any other described American *Gelechia*, is described from two perfect specimens, one collected in Arizona by Mr. E. A. Schwarz and the other probably bred by Mr. Koebele at Los Angeles, California.

GELECHIA ABELLA, new species.

Gelechia abella Busck, Dyar's List Amer. Lep., No. 5775, 1903.

Antennæ silvery white sharply annulated with dark fuscous. Labial palpi with rather small brush pure silvery white. Face and head pure white. Thorax suffused with fuscous; forewings white but so thickly suffused with fuscous as to obliterate the white ground-color except on apical third of the wing, which is pure white. Near base is an ill-defined oblique costal streak with only a few dark scales therefore appearing whitish against the darker surrounding parts. Cilia white. Hindwings as broad as forewings, light fuscous. Abdomen yellowish fuscous. Legs gray with white bars on the outside.

Alar expanse.—15 mm.

Habitat.—Colorado.

Type.—No. 6392, U.S.N.M.

This species which, by its peculiar coloration, probably imitates bird-droppings can not be mistaken for any other described species and is at once recognized by its pure white head, palpi, and apical third of the forewings.

GELECHIA FUSCOTÆNIAELLA Chambers.

- Gelechia fuscotæniella* CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 89, 143.—
 BUSCK, Dyar's List Amer. Lep., No. 5776, 1903.
Gelechia fuscotæniella RILEY, Smith's List Lep. Bor. Am., No. 5374, 1891.
Gelechia fuscoliniælla RILEY, Smith's List Lep. Bor. Am., No. 5370, 1891.

Type no. 451 in the U. S. National Museum of this species is labeled by Chambers *fuscotæniælla*, which, through misreading, led Riley to include the name *fuscoliniælla* in his list. This name consequently refers to the present species.

The type is identical with specimens in the Museum of Comparative Zoology in Cambridge, rightly labeled by Chambers. Both are in rather poor condition, but easily recognized from description by the pure white forewings with the sharply limited dark brown base.

The types are from Texas; in the National Museum there is also a better preserved specimen from Colorado.

B.—Unrecognized Species.

GELECHIA ADAPTERELLA Walker.

- Gelechia adapterella* WALKER, Cat. Lep. Het. Brit. Mus., XXIX, 1864, p. 590.—
 BUSCK, Dyar's List Amer. Lep., No. 5778, 1903.

This species was omitted in Riley's list. The type should be examined in the British Museum. Habitat not given by Walker.

GELECHIA ALBISTRIGELLA Chambers.

- Gelechia albistrigella* CHAMBERS, Can. Ent., IV, 1872, p. 171.—HAGEN, Papilio, IV, 1884, p. 98.—RILEY, Smith's List Lep. Bor. Am., No. 5304, 1891.
 BUSCK, Dyar's List Amer. Lep., No. 5779, 1903.

Two types of this species are in the Museum of Comparative Zoology in Cambridge, but in so poor condition that they can not be recognized with any degree of positiveness. They are, however, probably authentic, and remind one, as Chambers says, of *Strobisia*. As far as can be made out, without injuring the specimens, the forewings, which are obtusely rounded, have 11 veins, 8 coincident with 7, 3 and 4 stalked. Hindwings with 8 veins, 3 and 4 connate, 6 and 7 connate. Labial palpi with second joint considerably thickened with smoothly appressed scales, abruptly cut off at apex; terminal joint shorter than second joint.

However, it was so difficult to examine these specimens that I feel uncertain about the characters and must at present leave the species as unrecognized.

It is a rather striking insect and should easily be recognized from the description if found again.

Habitat.—Kentucky.

GELECHIA AMBROSICELLA Chambers.

Gelechia ambrosiella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 239; Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5308, 1901.—BUSCK, Dyar's List. Amer. Lep., No. 5780, 1902.

Chambers sent out to correspondents several specimens of a Tineid labeled: *Sinoë ambrosiella*, which he afterwards determined¹ as specimens of *Butalis matutella* Clemens. One of these was sent to U. S. National Museum, and when Riley made his List of 'Tineina he came across this specimen and recognizing Chambers' label, placed an asterisk by *ambrosiella* in his list, indicating that a specimen was found in the museum collection, without recognizing the faulty determination.

No types or recognized specimen of the present species are found in any of the collections, and I have failed to breed the species, although making several efforts. But the knowledge of the foodplant and larval habits [the larva feed according to Chambers in the fruits of *Ambrosia trifida*] together with the description insure ultimate rediscovery of the species, which Chambers thought very near to *Trichotaphe chambersella* Murtfeldt (p. 913).

GELECHIA AMORPHELLA Chambers.

Gelechia amorphella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 124; IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5309, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5781, 1902.

All authentic specimens of this species are lost and I have not recognized it from the description in the material examined, but continued collecting and breeding in Colorado ought to enable recognition of the species, the food plant of which Chambers gave with some doubt as *Amorpha fruticosa*.

GELECHIA ANGUSTIPENNELLA Clemens.

Gelechia angustipennella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, p. 119; Stainton Ed. N. Am. Tin., 1872, pp. 222, 224.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List. Lep. Bor. Am., No. 5311, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5782, 1902.

The type is lost and I have not recognized the species; the description gives no clew to the proper genus.

Habitat.—Pennsylvania!

¹Can. Ent., V, p. 231.

GELECHIA ARGENTIALBELLA Chambers.

Gelechia argentialbella CHAMBERS, Can. Ent., III, 1874, p. 241; Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5313, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5783, 1902.

No authentic material exists of this species, which, according to Chambers, is very like *Recurvaria variella* Chambers [p. 809].

Habitat.—Texas.

GELECHIA ATTRITELLA Walker.

Gelechia attritella WALKER, Cat. Brit. Mus., XXIX, 1864, p. 592.—BUSCK, Dyar's List Amer. Lep., No. 5784, 1902.

The type of this species should be examined in British Museum. The description gives no clue to the proper genus.

Habitat.—Not given.

GELECHIA DISCOMACULELLA Chambers.

Gelechia discomaculella CHAMBERS, Can. Ent., IV, 1872, p. 172; Cinn. Quart. Journ. Sci., II, 1875, p. 239; Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5353, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5785, 1902.

Gelechia aurimaculella CHAMBERS, Can. Ent., IV, 1872, p. 172; Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5316, 1891.

According to Miss Murtfeldt and Lord Walsingham the above synonymy is correct, but no authentic specimens of either species are now preserved. The descriptions read very much alike. According to Chambers this species is "difficult to distinguish from *Gelechia marmorella* Chambers,¹ even on comparison of specimens."

GELECHIA BADIOMACULELLA Chambers.

Gelechia badiomaculella CHAMBERS, Can. Ent., IV, 1872, p. 192; Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5317, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5786, 1902.

Described from a single specimen taken under a gaslight and with the palpi [at least!] burned. A yellowish and brown species with tufted wings, which will be difficult ever to rediscover with certainty, as it may not even belong to the family Gelechiidae.

Habitat.—Kentucky.

GELECHIA BISTRIGELLA Chambers.

Depressaria bistrigella CHAMBERS, Can. Ent., IV, 1872, pp. 92, 128, 147.

Gelechia bistrigella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5328, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5787, 1902.

Nothing can be said about the proper genus of this species from the description. Type is lost.

Habitat.—Canada.

¹ *Phthorinwa marmorella*, p. 823.

GELECHIA BRUMELLA Clemens.

Gelechia brumella CLEMENS, Proc. Ent. Soc. Phila., II, 1864, p. 416; Stainton Ed. N. Am. Tin., p. 239, 1872.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5330, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5788, 1902.

Described from a single somewhat denuded specimen from Labrador, which is no longer in existence.

GELECHIA CANOPULVELLA Chambers.

Gelechia canopulvella CHAMBERS, Bull. U. S. Geol. Surv., 1878, pp. 91, 142.—RILEY, Smith's List Lep. Bor. Am., No. 5332, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5789, 1902.

Of this species the unique type is still in the Museum of Comparative Zoology in Cambridge, but it is in so poor a condition that definite recognition is not possible at the present time. It is, however, without doubt a true *Gelechia*, near, if not the same as *Gelechia obscurousuffusella* Chambers [p. 888].

Habitat.—Texas.

GELECHIA CAPITEOCHRELLA Chambers.

Gelechia capiteochrella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 252; U. S. Geol. Surv. Bull., IV, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5333, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5790, 1902.

Can not be placed from description; type is lost; no locality given.

GELECHIA CARYÆVORELLA Packard.

Gelechia caryævorella PACKARD, Rept. U. S. Dept. of Agric., 1885, p. 331, 1886; Rept. U. S. Ent. Comm., V, 1890, p. 314.—RILEY, Smith's List Lep. Bor. Am., No. 5333a, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5791, 1902.

From the knowledge of the larva and the description of the imago it should not be difficult ultimately to rediscover this species, type of which is lost.

According to Professor Fernald it is allied to *Gelechia bicostomaculella* Chambers, and it may prove on discovery to be synonymous with one of the several similar species of that group.

Habitat.—Rhode Island.

GELECHIA CASSELLA Walker.

Gelechia cassella WALKER, Cat. Brit. Mus., XXIX, 1864, p. 594.—RILEY, Smith's List Lep. Bor. Am., No. 5333b, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5799, 1902.

The type of this species should be examined in British Museum. The description gives no clew to its proper genetic position.

-Exact habitat not given.

GELECHIA DECEMMACULELLA Chambers.

Gelechia decemmaculella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 290; Bull. U. S. Geol. Surv., III, 1877, p. 128; IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5349, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5793, 1902.

Described from a single captured specimen which is now lost. According to Chambers, "it reminds one in ornamentation of *Gelechia difficilisella* Chambers [*Epitheatis attributella* Walker p. 817], but is a larger insect with hindwings not excised beneath the tip."

Habitat.—Colorado.

GELECHIA BRACKENRIDGIELLA Busck.

Gelechia detersella CLEMENS (not Zeller), Proc. Acad. Nat. Sci. Phila., 1860, p. 164; Stainton Ed. N. Am. Tin., 1872, pp. 40, 116, 225.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5351, 1891.

Gelechia brackenridgiella BUSCK, Dyar's List Amer. Lep., No. 5794, 1902.

Cotypes of this species should be examined in British Museum, where the two specimens sent to Stainton by Clemens in 1860 presumably are found.

Stainton thought it allied to the European *Gelechia affinis* Douglas.¹

No types exist in this country of this species, which may be known under the above name instead of the preoccupied name *detersella*.

GELECHIA DISCOANULELLA Chambers.

Gelechia discoanulella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 254; Bull. U. S. Geol. Surv., IV, 1878, p. 143.—BUSCK, Dyar's List Amer. Lep., No. 5795, 1902.

Gelechia discoanulella RILEY, Smith's List Lep. Bor. Am., No. 5352, 1891.

According to Chambers, a pale ochreous species with dark, annulated spot at the end of the cell on forewings.

No type exists. No locality given.

GELECHIA DISCOSTRIGELLA Chambers.

Gelechia discostrigella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 248; Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5356, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5796, 1902.

Described from a single type with palpi missing. This unique type is still preserved in the Museum of Comparative Zoology in Cambridge, but now lacks, besides the palpi, part of all the wings, and it is in such condition as to prohibit generic recognition.

The type shows the species to be a large, broad-shouldered insect, with basal half of forewings white and extreme base blackish brown.

Habitat.—California.

¹*Beyotropha affinis* Staudinger and Rebel, Cat. Lep. Eur., No. 2531, 1901.

GELECHIA FLAVICORPORELLA Walsingham.

Gelechia flavicorporella WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 177.—RILEY, Smith's List Lep. Bor. Am., No. 5361, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5797, 1902.

Of this species two types are found in Professor Fernald's collection, but by accident I lost my notes on them and am at present unable to recognize the species.

It is, however, probably a true *Gelechia*.

GELECHIA FLEXURELLA Clemens.

Gelechia flexurella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 163; Proc. Ent. Soc. Phila., II, 1863, p. 122; Stainton Ed. N. Am. Tin., 1872, pp. 115, 225.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5363, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5798, 1902.

Type is lost; from Clemens's description I would suppose that this species probably belongs to the genus *Aristotelia*.

Habitat.—Pennsylvania

GELECHIA FUSCOLUTEELLA Chambers.

Depressaria fuscoluteella CHAMBERS, Can. Ent., IV, 1872, pp. 106, 147.
Gelechia fuscoluteella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5368, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5799, 1902

No authentic specimens exist, and the short description is insufficient for recognition.

Habitat.—Kentucky.

GELECHIA FUSCOMACULELLA Chambers.

Gelechia fuscomaculella CHAMBERS, Can. Ent., IV, 1872, p. 170; Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5369, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5800, 1902.

The unique type of this species in the Museum of Comparative Zoology in Cambridge is in very poor condition, with one forewing and part of the other and of both hindwings gone.

It is impossible to place it with certainty, but I believe it is a true *Gelechia*.

Habitat.—Kentucky.

GELECHIA FUSCOPUNCTELLA Clemens.

Gelechia fuscopunctella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, pp. 12, 121; Stainton Ed. N. Am. Tin., 1872, pp. 218, 225.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5373, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5801, 1902.

Type is lost and description insufficient for certain generic determination.

Habitat.—Pennsylvania?

GELECHIA GILVOMACULELLA Clemens.

Gelechia gilvomaculella CLEMENS, Proc. Ent. Soc. Phila., 1863, II, pp. 12, 121; Stainton Ed. N. Am. Til., 1872, pp. 218, 225.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5381, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5802, 1902.

The type is lost and description insufficient for generic determination.
Habitat.—Pennsylvania?

GELECHIA GLYCYRIZÆELLA Chambers.

Gelechia glycyrizæella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 124 —BUSCK, Dyar's List Amer. Lep., No. 5803, 1902.

Gelechia glycyrrizæella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5384, 1891.

The unique type of this species is in rather well-preserved condition in the Museum of Comparative Zoology in Cambridge. But I have not been able to find another specimen exactly like it in any of the collections, and as I can not with absolute certainty make out the genus of the type specimen without injuring it, I prefer, therefore, to postpone definite determination of the species until more material is at hand. It is probably a true *Gelechia*. Food plant was given with some doubt by Chambers as *Glycyrrhiza lepidota*.

Habitat.—Colorado.

GELECHIA GRISELLA Chambers.

Gelechia grisella CHAMBERS, Can. Ent., IV, 1872, p. 171; Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5385, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5804, 1902.

The type is lost and the description is insufficient for generic determination.

Habitat.—Kentucky.

GELECHIA GRISEAELLA Chambers.

Parasia griseaella CHAMBERS, Can. Ent., 1872, IV, p. 88.

Gelechia griseaella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5386, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5805, 1902.

The type is lost and the description insufficient for generic determination.

Habitat.—Canada.

GELECHIA GRISEOCHRELLA Chambers.

Gelechia griseochrella CHAMBERS, Cinn. Quart. Jour. Sci., II, 1875, p. 247; Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5387, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5806, 1902.

The type is lost. From Chambers' description and his comparison of the venation with that of *Callima argenticinctella* Clemens, it seems

highly probable that this species does not even belong in the family Gelechiidae. However, as it can not at present be placed elsewhere it must remain under the present genus until recognized.

Habitat.—California.

GELECHIA LABRADORICA Moeschler.

Gelechia labradorica MOESCHLER, Wien. Ent. Monatsch., 1864, p. 200.—GROTE, Can. Ent., IV, 1872, p. 125.—CHAMBERS, Bull. U. S. Geol. Surv., IV, p. 144, 1878.—RILEY, Smith's List Lep. Bor. Am., No. 5395, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5807, 1902.

Presumably a true *Gelechia*, but which can not be definitely placed from the description.

Habitat.—Labrador.

GELECHIA LABRADORIELLA Clemens.

Gelechia labradoriella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, pp. 12, 120; Stainton Ed. N. Am. Tin., 1872, pp. 220, 224, 239.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5396, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5808, 1902.

? *Gelechia viduella* FABRICIUS, Staudinger & Rebel, Cat. Lep. Eur., II, No. 2618. 1901.

Placed by Staudinger and Rebel as a synonym of the European *Gelechia viduella* Fabricius, with a question mark. No authentic material of Clemens' is left, but the evidently rather striking species should be recognized from the description when fuller collections from Labrador are obtained.

GELECHIA LACTEUSOCHRELLA Chambers.

Gelechia lacteuschrella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 244; Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5397, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5810, 1902.

The type of this species is lost and the description gives no evidence of the true generic position of the species.

Habitat.—California.

GELECHIA LITURELLA Walker.

Gelechia liturella WALKER, Cat. Brit. Mus., XXIX, 1864, p. 591.—BUSCK, Dyar's List Amer. Lep., No. 5811, 1902.

Type should be examined in British Museum.

GELCHIA MACULATUSELLA Chambers.

Gelechia maculatusella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 245; Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5404, 1891.—BUSCK, Dyar's List Amer. Lep., 5812, 1902.

The type is lost and the description is insufficient for generic determination.

Habitat.—California.

GELECHIA MILLERIELLA Chambers.

Gelechia milleriella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 253; Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5408, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5813, 1902.

The type is lost and description insufficient for generic determination.

Habitat.—Not given.

GELECHIA MIMELLA Clemens.

Gelechia mimella CLEMENS, Proc. Acad. Nat. Sci., Phila., 1860, p. 163; Proc. Ent. Soc. Phila., II, 1863, p. 121; Stainton Ed. N. Am. Tin., 1872, pp. 116, 225.—CHAMBERS, Can. Ent., IV, 1872, p. 69; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5409, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5814, 1902.

The type of the species is lost; Chambers thought it similar or possibly even synonymous with his *Gelechia palpiannulella* (*Aristotelia absconditella*, Walker, p. 801), but Clemens expressly said in his synoptic table of his species of *Gelechia* that *mimella* has hindwings with rounded apex, not produced, and it can consequently not be looked for in *Aristotelia*.

Habitat.—Pennsylvania?

GELECHIA OBSCURELLA Chambers.

Gelechia obscurella CHAMBERS, Can. Ent., IV., 1872, p. 170; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5423, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5815, 1902.

In the Cambridge Museum is found a type of this species, which shows it to be a true *Gelechia* similar to, but different from, *Gelechia monumentella* Chambers [p. 888]. Chambers himself thought it similar to the following unrecognized species. The type is, however, in so poor condition that I have not been able to identify it specifically with certainty, and much fuller collections should be made in Chambers' old hunting grounds in Kentucky before definite determination is attempted.

GELECHIA OBSCURUSELLA Chambers.

Depressaria obscurusella CHAMBERS, Can. Ent., 1872, pp. 106, 129, 148; Bull. U. S. Geol. Surv., IV, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5426, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5816, 1902.

Gelechia fuscopolvella CHAMBERS, Can. Ent., IV, 1872, p. 170; Cinn. Quart. Journ. Sci., II, 1875, p. 245; Bull. U. S. Geol. Surv., IV, 1878, p. 143.—RILEY, Smith's List Lep. Bor. Am., No. 5372, 1891.

Types of both the above species are found in the Cambridge Museum, but in nearly useless condition. They seem, however, absolutely identical so far as comparison is possible, and, as the two descriptions also agree, I have no hesitation in uniting them. The species is probably a

true *Gelechia* and possibly the same as the foregoing species, though I think I am able to differentiate the two excuses for types.

Habitat.—Kentucky, Canada.

GELECHIA OCHERFUSCELLA Chambers.

Gelechia ocherfuscella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 249.—BUSCK, Dyar's List Amer. Lep., No. 5817, 1902.

Gelechia ochrofuscella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5429, 1891.

Described from a single specimen without palpi, which is now lost. Nothing can be said from the description about the generic position of the species.

Habitat.—California.

GELECHIA ORNATIFIMBRIELLA Clemens.

Gelechia? ornatifimbriella CLEMENS, Proc. Ent. Soc. Phil., II, 1864, p. 420; Stainton Ent. N. Am. Tin., 1872, p. 242.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5435.—BUSCK, Dyar's List Amer. Lep., No. 5818, 1902.

The types of this species are lost, and Clemens thought it an aberrant from approaching *Depressaria*. As far as his description of the venation and palpi is concerned it fits the present genus, but I have not identified it specifically.

Habitat.—Illinois.

GELECHIA PALLIDAGRISELLA Chambers.

Gelechia pallidagriseella CHAMBERS, Can. Ent., VI, 1874, p. 237.—BUSCK, Dyar's List Amer. Lep., No. 5819, 1902.

Gelechia pallidegriseella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5438.

The type is lost. Nothing can be gleaned from the description about the generic position of the species.

Habitat.—Texas.

GELECHIA PALPIALBELLA Chambers.

Gelechia palpialbella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1878, p. 253; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—BUSCK, Dyar's List Amer. Lep., No. 5820, 1902

Gelechia palpiaella RILEY, Smith's List Lep. Bor. Am., No. 5441, 1891.

The type of the species is lost and the description insufficient for correct generic determination. Chambers said it is mistakable for *Gelechia (Aristotelia) physaliella* Chambers [p. 802].

No habitat is given.

GELECHIA PARVIPULVELLA Chambers.

Gelechia parvipulvella CHAMBERS, Can. Ent., VI, 1874, p. 242; Bull. U. S. Geol. Surv., IV, 1878, p. 145.—RILEY, Smith's List Lep. Bor. Am., No. 5443, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5821, 1902.

The type of the species is lost.

The following is a rather extreme but by no means unique example of some of Chambers' descriptions, which will serve to illustrate the difficulties connected with recognizing some of his species of which his types are lost, especially when it is borne in mind, that there is no assurance that the insects he placed under *Gelechia* belongs to the family *Gelechiidae* even:

Palpi simple. Pale yellowish white, lightly dusted with fuscous, the dusting more dense toward the apex of the primaries. Al. exp. $\frac{3}{8}$ inch. Season, May and August. Possibly a variety of *G. subalbusella*.

The description of *Gelechia subalbusella* is still more laconic and reads in full:

Second joint of the palpi not thickened. Creamy white, sparsely dusted with ochreous yellow and brown.

Habitat.—Texas.

GELECHIA PULLIFIMBRIELLA Clemens.

Gelechia pullifimbriella CLEMENS, Proc. Ent. Soc. Phila., II, 1863, p. 120; Stainton Ed. N. Am. Tin., 1872, pp. 223, 225.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5455, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5822, 1902.

Type is lost and description is insufficient for generic determination of the species.

Habitat.—Pennsylvania?

GELECHIA PULLUSELLA Chambers.

Gelechia pullusella CHAMBERS, Can. Ent., VI, 1874, p. 237; Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5456; Busck, Dyar's List Amer. Lep., No. 5823, 1902.

The type is lost and the description is insufficient for determination.

Habitat.—Texas.

GELECHIA PUNCTIFERELLA Clemens.

Gelechia punctiferella CLEMENS, Proc. Ent. Soc. Phila., II, 1864, p. 119; Stainton Ed. N. Am. Tin., 1872, pp. 222, 224.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5457, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5824, 1902.

The type is lost and the description is insufficient for final generic determination.

Habitat.—Pennsylvania?

GELECHIA SIMPLICIELLA Chambers.

Gelechia simpliciella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 238; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5483, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5825, 1902.

The type is lost and definite determination of the species impossible from the description.

Chambers says it has some resemblance to a worn specimen of *Gelechia solaniella* Chambers (*Phthorimæa glochinella*, Zeller, p. 822).

Habitat.—Kentucky.

GELECHIA SUBALBUSELLA Chambers.

Gelechia subalbusella CHAMBERS, Can. Ent., VI, 1874, p. 242.—RILEY, Smith's List Lep. Bor. Am., No. 5485.—BUSCK, Dyar's List Amer. Lep., No. 5826, 1902.

Type is lost and nothing definite can be said concerning the proper genus of the species from the description.

Habitat.—Texas.

GELECHIA SUFFUSELLA Chambers.

Gelechia suffusella CHAMBERS, Can. Ent., IV, 1872, p. 171; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5488, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5827, 1902.

The six specimens supposed to be types of the species, placed as such in the Cambridge Museum and recorded by Hagen,¹ were found on examination to be specimens of *Gelechia rufusella* Chambers (*Anacampsis fullonella*, p. 849), and thus labeled by Chambers.

No types of *suffusella* exist, and nothing can be said from the description about the generic position of that species.

Habitat.—Kentucky.

GELECHIA THORACEOCHRELLA Chambers.

Gelechia thoraceochrella CHAMBERS, Can. Ent., IV, 1872, p. 169; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5493.—BUSCK, Dyar's List Am. Lep., No. 5828, 1902.

No types are found and description is insufficient for definite generic determination.

Habitat.—Kentucky.

GELECHIA THORACESTRIGELLA Chambers.

Gelechia thoracestrigella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 245; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5496, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5829, 1902.

No types are in existence.

Chambers says about this and about the foregoing species, as well as about *thoracealbella* (p. 867), that they are very similar to *Gelechia fuscopulcella*. Probably they are all like *thoracealbella*, true *Gelechia*.

Habitat.—California.

GELECHIA UNISTRIGELLA Chambers.

Gelechia? unistrigella CHAMBERS, Can. Ent., V, 1873, p. 176.—RILEY, Smith's List Lep. Bor. Am., No. 5504, 1891.—BUSCK, Dyar's List Am. Lep., No. 5831, 1902.

Type is lost. The species can not be definitely determined generically from the description.

Habitat.—Kentucky.

¹ Papilio, IV, p. 99.

GELECHIA VERSICOLORELLA Chambers.

Depressaria versicolorella CHAMBERS, Can. Ent., IV, 1872, pp. 127, 129, 148; Bull. U. S. Geol. Surv., IV, 1872, p. 138.—RILEY, Smith's List Lep. Bor. Am., No. 5284, 1891.

Gelechia versicolorella RILEY, Smith's List Lep. Bor. Am., No. 5509, 1891.—BUSCK, Proc. U. S. Nat. Mus., XXIV, 1902, p. 732; Dyar's List Amer. Lep., No. 5832, 1902.

As shown by me, this species must be a Gelechiid, but definite determination of the genus can not be obtained from the description. Type is lost.

Habitat.—Kentucky.

GELECHIA WACOELLA Chambers.

Gelechia wacoella CHAMBERS, Can. Ent., VI, 1874, p. 237; Bull. U. S. Geol. Surv., IV, 1878, p. 148.—RILEY, Smith's List Lep. Bor. Am., No. 5511, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5833, 1902.

Type is lost and exact generic determination is impossible from the description alone.

Habitat.—Texas.

MENESTA Clemens.

Plate XXXI, fig. 30.

Menesta CLEMENS, Proc. Ent. Soc. Phila., 1860, p. 213.

Hyale CHAMBERS, Cin. Quart. Jn. Sci., II, 1875, p. 242.

The characters of this genus in accordance with Clemens's description and verified by an undoubted specimen of the type of the genus are as follows: Labial palpi smooth, slender, curved, ascending, reaching vertex; second joint slightly thickened toward apex, terminal shorter than second, smooth, slender, pointed. Forewing short, broad, tortricid-formed apical edge nearly perpendicular on costal and dorsal edge; 10 veins, veins 4 and 8 absent, all separate, 7 to apex. Hindwings over I., 7 veins, 5 absent, 3 and 4 connate, 6 and 7 stalked.

Lord Walsingham's suggestion¹ that this genus is hardly rightly separated from *Stenoneta* Zeller is far from right. Neither is his conception of the venation clear. In the article just referred to in his tabulation of the supposed allied genera he writes that veins 7 and 8 in forewing are separate, and he further says² that *Menesta cinerocervina* Walsingham, the venation of which he gives, differs in venation from the genus only in having veins 6 and 7 in hindwing connate instead of stalked, thus inferring that *Menesta*, like this species, has 11 veins in forewing and 8 in hindwing, while in reality it has only 10 and 7, respectively.

Chambers suggested and Lord Walsingham established the synonymy *Menesta* Clemens-*Hyale* Chambers, about which there can not be any doubt.

¹ Insect Life, II, p. 154.

² Proc. Lond. Zool. Soc., 1895, p. 85.

The genus is an interesting one, related to *Strobisia* Clemens, and probably confined to America.

The three species at present known have all the same venation and are of great general resemblance, but easily separated by the different striking white markings.

With white costal spot.....	<i>melanella</i> , p. 903
Without costal spot.....	1
With apical cilia white.....	<i>albaciliella</i> , p. 903
Apical cilia not white.....	<i>tortriciformella</i> , p. 903

MENESTA TORTRICIFORMELLA Clemens.

Menesta tortriciformella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 213; Stainton Ed. Tin. N. Am., 1872, p. 151.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 150.—WALSINGHAM, Proc. Zool. Soc. Lond., 1881, p. 319; Insect Life, II, 1889, p. 154.—RILEY, Smith's List Lep. Bor. Am., No. 5227, 1891.—BUSCK, Dyar's List. Am. Lep., No. 5650, 1902.

Gelechia liturella WALKER, Cat. Lep. Brit. Mus., XXIX, 1864, p. 591.

Hyale coryliella CHAMBERS, Cinn. Quart. Journ. Sci., II, p. 242; Bull. U. S. Geol. Surv., IV, 1878, p. 157.

Gelechia coryliella PACKARD, Rep. U. S. Ent. Comm., V, 1890, p. 635.

Chambers' interesting life history of this species on hazel is quite similar to Miss Murtfeldt's excellent observations on the following species, *melanella* Murtfeldt, on oak, and further confirms the identity of *Hyale* and *Menesta*.

This species is probably local and is not common.

The specimen in the U. S. National Museum is from Massachusetts. Clemens' type presumably came from Pennsylvania, and Chambers described the species from Kentucky.

MENESTA MELANELLA Murtfeldt.

Menesta melanella MURTFELDT, Insect Life, II, 1890, p. 304.—RILEY, Smith's List Lep. Bor. Am., No. 5228, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5651, 1902.

This easily recognized species is well described by Miss Murtfeldt, and the interesting life history is carefully recorded with figure.

Food plant.—Oak.

Habitat.—Missouri.

A cotype and good bred series from Miss Murtfeldt are in the U. S. National Museum.

MENESTA ALBACILIÆELLA Chambers.

Strobisia albaciliæella CHAMBERS, Can. Ent., X, 1878, p. 77; Bull. U. S. Geol. Surv., IV, 1878, p. 162.—RILEY, Smith's List Lep. Bor. Am., No. 5580, 1891.

Menesta albaciliæella BUSCK, Dyar's List Amer. Lep., No. 5652, 1902.

This strikingly beautiful insect was described from a single specimen from Cincinnati. This unique type is found in easily recognizable condition in the Cambridge Museum, where I had an opportunity

to examine it. It bears Chambers' handwriting on the label, "*Strobisia albaciliella* Cham.," and it is undoubtedly authentic.

It is clearly a *Menesta*, agreeing perfectly in venation and palpi with this genus, and is very closely related to the two other species in the genus, but is at once distinguished by the white apical cilia in forewing, which contrasts beautifully with the very dark shining wing. I have only seen one other specimen of this fine species, namely, in Mr. Kearfott's collection, where is found a well-preserved specimen collected by him in New Jersey, on June 17.

STROBISIA Clemens.

Plate XXXI, fig. 31-32.

Strobisia CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 164.

This genus is well characterized by Clemens, and has the following characters:

Labial palpi perfectly smooth, curved, slender; second joint scarcely thickened, terminal joint as long as second, pointed. Forewing elongate ovate, apex obtusely pointed; 12 veins, 7 and 8 stalked, or 11 veins, 7 and 8 coincident, 2 and 3 stalked. Hindwings narrower than forewing, apex obtuse, termen slightly sinuate; 8 veins, 3 and 4 connate, 5 parallel, 6 and 7 connate. The species have dark hindwings and brilliant iridescent markings on forewings. The genus is nearly related to *Trichotaphe* Clemens.

Two species hitherto placed in this genus I have transferred to other genera, namely, *levipedella* Clemens, which belongs to *Anacampsis*, near *tristrigella* Walsingham, and will be found treated under that genus (p. 844), and *albaciliella* Chambers, which belongs to and will be found treated under *Menesta*.

The name *argenticiliella* Chambers as found in Chambers' "Index," p. 162, and in Smith's check list, No. 5581, does not appear to correspond to any description. The reference given in "Index"¹ is not correct, and the name must be dropped.

Only two described species are at present referable to this genus. They may be separated thus:

Metallic markings, narrow dashes and dots.....*irridipennella*, p. 904
Metallic markings, broad spots and bands*emblemella*, p. 905

STROBISIA IRRIDIPENNELLA Clemens.

Strobisia irridipennella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 165; Stainton Ed. N. Am. Tin., 1872, pp. 40, 118.—CHAMBERS, Can. Ent., IV, 1872, p. 89; Bull. U. S. Geol. Surv., IV, 1878, p. 162.—FREY, Stett. Ent. Zeit., XXXIX, 1878, p. 251.—RILEY, Smith's List Lep. Bor. Am., No. 5583, 1891.—DIETZ, Smith's List Ins. New Jersey, p. 474, 1900.—BUSCK, Dyar's List Amer. Lep., No. 5653, 1902.

¹Can. Ent., X.

Strobisia aphroditeella CHAMBERS, Can. Ent., IV, 1872, p. 88.—FREY, Stett. Ent. Zeit., XXXIX, 1878, p. 251.

Strobisia proserpinella FREY, Stett. Ent. Zeit., XXXIX, 1878, p. 251.—RILEY, Smith's List Lep. Bor. Am., No. 5585, 1891.

This species is the type of the genus and the more specialized of the two species. It has veins 7 and 8 in the forewings coincident.

Chambers is himself responsible for placing his *aphroditeella* as a synonym of *irridipennella*, which the description indicates is the case. He committed, however, a clerical mistake in doing it. He wrote:¹

Strobisia venustella I am now satisfied is a synonym of *S. irridipennella* Clemens. Because of the presence of several brilliant blue spots on the wings of my specimens not mentioned in Dr. Clemens' description, I was led to believe that they belonged to a different species. But the individuals vary in this respect.

There can be no question but that *venustella* is a mistake for *aphroditeella*, the description of which only can be applied to *irridipennella*. This is also demonstrated by Chambers afterwards in his "Index,"² where he placed his species right, *aphroditeella* as synonym of *irridipennella* and *venustella* as synonym of the following species, *emblemella* Clemens.

On account of the same defects in Clemens' description, which misled Chambers, Frey described his *proserpinella*, which undoubtedly is the same as *irridipennella*, the description agreeing in every particular.

Although this species is very abundant in the vicinity of Washington, and though I have given special attention to it for some years, its larval history is as yet entirely unknown, and furnishes a worthy subject for study for any student who has an opportunity to work it out. The larva will, I believe, be found to be a stem borer.

STROBISIA EMBLEMELLA Clemens.

Strobisia emblemella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 164; Stainton Ed. N. Am. Tin., 1872, pp. 40, 118.—CHAMBERS, Can. Ent., IV, 1872, pp. 89, 90; Bull. U. S. Geol. Surv., IV, 1878, p. 162.—FREY, Stett. Ent. Zeitung, XXXIX, 1878, p. 251.—RILEY, Smith's List Lep. Bor. Am., No. 5583, 1891.—DIETZ, Smith's List Ins. N. J., 1900, p. 474.—BUSCK, Dyar's List Amer. Lep., No. 5654, 1902.

Strobisia venustella CHAMBERS, Can. Ent., IV., 1872, p. 90.

This well-described species differs generically from the type only by having vein 8 in forewings present, out of vein 7. A specimen determined by Lord Walsingham and by the writer are in the U. S. National Museum.

It is not nearly as common in the localities around Washington as the preceding species.

¹ Can. Ent., VI, p. 7.

² U. S. Geol. Surv. Bull., IV, p. 162.

TRICHOTAPHE Clemens.

Plate XXXII, fig. 33.

Trichotaphe CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 166.*Begoë* CHAMBERS, Can. Ent., IV, 1872, p. 24.*Epicorthylis* ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 248.*Malacotricha* ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 282.

Begoë Chambers is the same as *Malacotricha* Zeller, erected on the same species.

I have before me authentic specimens of the types and of all American species hitherto included in these three genera, besides several other described and undescribed species belonging to this group.

After examining them very carefully, and after comparing critically the descriptions and figures given by the authors, it is my opinion that these three genera are artificial divisions of one natural group, and that they should not be retained.

All three genera have exactly the same venation, wing form, and general habitus, and differ only in the slight modification of the hairs on second joint of the labial palpi, *Trichotaphe* being supposed to include the forms with perfectly smooth though thickened palpi; *Begoë* (*Malacotricha*) those where the hairs on the upper (inner) side of second joint are somewhat longer and looser, and *Epicorthylis* representing those where these hairs are still more developed.

-However, these differences pass so gradually into each other that in most cases a species can be equally well placed in two of the genera, and species which are evidently very close otherwise will be found to differ in respect to these hairs, while others, clearly farther apart, will be found to agree in the form of the palpi.

In his characterization of *Trichotaphe* Clemens was aware of these modifications of the labial palpi, but rightfully gave them only specific value.

Zeller himself also conceded this¹ and wrote:

Wahrscheinlich haben die *Malacotrichen* gleichen Aderverlauf [as *Trichotaphe* (A. B.)]. Die kleine Verschiedenheit in der Behaarung der Taster zwischen *Malacotriche* und *Trichotaphe* hat Clemens sicher mit Recht nicht als Gattungsmerkmal betrachtet.

And anyone who will compare Zeller's figures of *Epicorthylis* and *Malacotriche*² and who knows that the venation and other characters are identical in the two forms will be apt to concede that the two genera are not separable.

The genus *Trichotaphe* as here used, including all these closely related forms is near *Ypsolophus*, and some of the species approach this genus markedly in the form of the palpi as well as in coloration.

¹Verh. k. k. zool.-bot. Gesell. Wien, XXIII, p. 279.

²Pl. III, fig. 13 a. b. and fig. 28 a. b.

Striking instances of this are *Trichotaphe setosella* Clemens compared with *Ypsolophus eupatoriella* Chambers and *Trichotaphe serrativittella* Zeller compared with *Ypsolophus ligulellus* Hübner.

On the other hand *Trichotaphe* comes very close to *Anacampsis* Curtis, differing only in the somewhat shorter palpi and in having veins 2 and 3 in forewing stalked.

The genus has the following characters: Antennæ serrate, often more or less ciliated. Labial palpi long, recurved, second joint thickened with scales, appressed and smooth in front and laterally, smooth or more or less long-haired above (on the inside); terminal joint long, but shorter than second joint, slender, smooth, pointed. Forewings elongate, apex obtuse, 12^{veins}, 7 and 8 stalked, 2 and 3 stalked. Hindwings broader than forewings, slightly sinuate below apex, trapezoidal, and angle rounded; 8 veins, 3 and 4 connate with a tendency to become short-stalked, 5 approximate to 4, 6 and 7 connate with a tendency to become short-stalked. Discal vein in several species with a tendency to become obsolete.

Depressaria georgiella Walker, which Lord Walsingham placed in this genus, is unknown to me except from the description, but this, if correct, clearly shows that the species can not be a *Trichotaphe*.

However, as I do not know the species, it must for the present remain in *Trichotaphe*, as Walsingham has placed it, but it is not included in the synoptic table, by which the species at present recognized may be separated.

Ground color of forewings dark, nearly black.....	1
Ground color lighter, fuscous brown or yellow.....	9
1. Forewings with light costal edge.....	2
Costal edge not light.....	5
2. Head and costa reddish brown.....	<i>costarufjella</i> , p. 909
Head and costa light ochereous.....	3
3. Costal light area with curved pointed process into the dark dorsal area.	
<i>flavocostella</i> , p. 908	
Costal light area without such process.....	4
4. Dorsal dark area with single rounded process into the costal light area.	
<i>inserrata</i> , p. 908	
Dorsal dark area with two small sharp processes into the costal light area.	
<i>serrativittella</i> , p. 909	
5. Forewings with strong metallic reflections.....	6
Forewings without such reflections.....	8
6. With light ochereous costal spot at apical third.....	<i>alacella</i> , p. 909
Without such ochereous spot.....	7
7. With small whitish dot at end of cell.....	<i>purpureofusca</i> , p. 910
Without such dot.....	<i>nonsteigella</i> , p. 910
8. Labial palpi light ochereous.....	<i>juncidella</i> , p. 910
Labial palpi dark.....	<i>melantherella</i> , p. 911
9. Ground color of forewings light ochereous with no transverse markings.....	10
Ground color gray, brown or fuscous with transverse markings.....	14
10. Forewings overlaid with dark scales.....	<i>chambersella</i> , p. 913
Forewings at most sprinkled with dark scales.....	11

11. With dark spot on fold.....	12
Without such spot.....	13
12. Forewings ocherous.....	<i>trimaculella</i> , p. 914
Forewings yellowish white.....	<i>lactiflosella</i> , p. 914
13. Head whitish.....	<i>fernaldella</i> , p. 915
Head ocherous.....	<i>bidiscomaculella</i> , p. 914
14. Costal edge ocherous.....	<i>setosella</i> , p. 911
Costal edge not ocherous.....	15
15. Head and thorax brown.....	<i>condulivorella</i> , p. 913
Head and thorax whitish fuscous.....	<i>inversella</i> , p. 912
Not included in table.....	<i>georgiella</i> , p. 916

TRICHOTAPHE FLAVOCOSTELLA Clemens.

Gelechia ? *flavocostella* CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 162; Stainton Ed. N. Am. Tin., 1872, p. 113.

Trichotaphe flavocostella CLEMENS, Proc. Ent. Soc. Phila., I, 1862, p. 131; Stainton Ed. N. Am. Tin., 1872, p. 180.—BUSCK, Dyar's List Amer. Lep., No. 5655, 1902.

Gelechia (*Trichotaphe*) *flavocostella* ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, pl. IV, fig. 26, 1873, p. 279.

Gelechia flavocostella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.—COQUILLET, Rep. State Ent. Nox. Ben. Ins. Ill., X, 1881, p. 153.

Gelechia flavocostella WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 184.—RILEY, Smith's List Lep. N. Am. No. 5362, 1891.

Trichotaphe flavocostella DIETZ, Smith's List Ins. N. Jersey, 1900, p. 475.

This strikingly marked species is quite commonly taken at light in the vicinity of Washington City. It was described by Zeller from Massachusetts, while Clemens' specimen came from Maine. In the National Museum are specimens from Illinois, Iowa, New York, Missouri, District of Columbia, and Georgia.

Mr. Coquillett recorded the food plant as sunflower (*Helianthus*). It has been bred by Miss Murtfeldt and in the insectary of the Department of Agriculture from *Solidago*, from which plant I have also bred it, I am sorry to say without sufficiently careful notes to be able to give the differences between the larvæ of this and of the following species, *inserrata* Walsingham, which are quite similar. I have even a suspicion that the two species may prove to be varieties of one species.

TRICHOTAPHE INSERRATA Walsingham.

Gelechia (*Trichotaphe*) *inserrata* WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 184.

Gelechia inserrata RILEY, Smith's List Lep. Bor. Am., No. 5391, 1891.

Trichotaphe inserrata BUSCK, Dyar's List Amer. Lep., No. 5656, 1902.

This species has been bred by Miss Murtfeldt and myself from *Solidago*, and is commonly found in company with the foregoing species among these plants.

The type is in Professor Fernald's collection, where I have compared it with specimen from U. S. National Museum.

The species comes to light freely.

TRICHOTAPHE SERRATIVITTELLA Zeller.

Gelechia (Trichotaphe) serrativittella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 280, pl. IV, fig. 27.

Gelechia serrativittella CHAMBERS, Can. Ent., IX, 1877, p. 24; Bull. U. S. Geol. Surv., IV, 1878, p. 147.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 184.—RILEY, Smith's List Lep. Bor. Am., No. 5480, 1891.

Gelechia plutella CHAMBERS, Can. Ent., VI, 1874, p. 238; Bull. U. S. Geol. Surv., IV, 1878, p. 146.—RILEY, Smith's List Lep. Bor. Am., No. 5449, 1891.

Trichotaphe serrativittella BUSCK, Dyar's List Amer. Lep., No. 5657, 1902.

Zeller's type is in Cambridge. The type of *Gelechia plutella* Chambers is presumably lost, but there seems no reason to doubt this apparent synonymy, which Chambers himself suggested.

In the U. S. National Museum are specimens from Kansas (Creve-cœur), and several specimens taken at light in the vicinity of Washington City by the writer.

TRICHOTAPHE COSTARUFOELLA Chambers.

Gelechia costarufoella CHAMBERS, Can. Ent., VI, 1874, p. 240.

Gelechia costarufoella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 142.—RILEY, Smith's List Lep. Bor. Am., No. 5345, 1891.

Trichotaphe costarufoella BUSCK, Dyar's List Amer. Lep., No. 5658, 1902.

The description of this species suggests that it is a *Trichotaphe*, and this was verified by examining types in Professor Fernald's collection and in the Museum of Comparative Zoology in Cambridge, all in miserable condition, but bearing Chambers' labels and undoubtedly representing this species, which is easily recognized by Chambers' description.

One specimen of this species is in the U. S. National Museum, which Lord Walsingham by mistake has labeled *Trichotaphe setosella?* It has no locality label.

Chambers' types are from Texas.

TRICHOTAPHE ALACELLA Clemens.

Trichotaphe alacella CLEMENS, Proc. Ent. Soc. Phila., 1860, p. 132; Stainton Ed. N. Am. Tin., 1872, p. 180.—DIETZ, Smith's List Ins. N. Jersey, 1900, p. 474.—BUSCK, Dyar's List Amer. Lep., No. 5659, 1902.

Gelechia alacella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5302, 1891.

Gelechia (Trichotaphe) ochripalpella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 279.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 183.

Gelechia ochripalpella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 145.

Gelechia goodella CHAMBERS, Journ. Cinn. Soc. Nat. Hist., III, 1881, p. 289.

Zeller changes the name of this species because of the preoccupation of *alacella*, but this contention will not hold on account of *Acanthophila alacella* Dupont, and the present species should be known under Clemens' original name.

I have examined Chambers' type of *Gelechia gooddella* in Professor Fernald's collection, which Lord Walsingham had before him in 1882. It is undoubtedly the same as Clemens' species, the type of which is lost. Chambers' type came from Massachusetts, Clemens' type presumably from Pennsylvania; Zeller's specimens were from Washington City.

In the U. S. National Museum are specimens from all these localities and from New York.

TRICHOTAPHE PURPUREOFUSCA Walsingham.

Gelechia (Trichotaphe) purpureofusca WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 184.

Gelechia purpureofusca RILEY, Smith's List Lep. Bor. Am., No. 5458, 1891.

Trichotaphe purpureofusca BUSCK, Dyar's List Amer. Lep., No 5660, 1902.

This splendid insect I have easily identified among the unnamed material in the U. S. National Museum. I have later examined the type in Professor Fernald's collection.

It is our largest described species of this genus. The large orange-yellow palpi contrast strikingly with the dark purplish shining forewings.

Food plant is not known.

TRICHOTAPHE NONSTRIGELLA Chambers.

Dasycera nonstrigella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 92, 138.—RILEY, Smith's List Lep. Bor. Am., No. 5546.

Trichotaphe nonstrigella BUSCK, Dyar's List Amer. Lep., No. 5661, 1902.

This species was described from a single female specimen, collected in Kentucky, "resting on a leaf in the woods June 30."

This unique type is found in the Museum of Comparative Zoology in Cambridge, in easily recognizable condition, agreeing minutely with Chambers' description and bearing his label.

It was somewhat of a surprise to find it to be a Gelechiid with wing-form, venation, and palpi agreeing exactly with the present genus.

The densely ciliated antennæ which Chambers describes surely are remarkable. Ciliate and serrate antennæ are found in all the species of *Trichotaphe*, but in this species they are unusually developed.

Still, there is no doubt that the species rightfully belongs to the present genus and quite near the foregoing species.

In the U. S. National Museum is a single specimen from Kansas (Crevecoeur), and I have examined one other specimen collected near Chambers' locality by Miss Annette Braun of Cincinnati, Ohio.

TRICHOTAPHE JUNCIDELLA Clemens.

Trichotaphe juncidella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 166; Stainton Ed. N. Am. Tin., 1872, p. 122.—BUSCK, Dyar's List Amer. Lep., No. 5662, 1902.

- Gelechia juucidella* CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 144.
Gelechia (Trichotaphe) juucidella WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 183.
Gelechia pallipalpis WALKER, Cat. Lep. Het. Brit. Mus., XXIX, 1864, p. 596.
Depressaria? dubitella CHAMBERS, Can. Ent., IV, 1872, pp. 90, 91, 92, 128.
Gelechia dubitella CHAMBERS, Can. Ent., IV, 1872, p. 147; Bull. U. S. Geol. Surv., IV, 1878, p. 116.
Gelechia (Cryptolechia) dubitella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 143.
Depressaria (Gelechia) dubitella MURTFELDT, Can. Ent., VI, 1874, p. 221.
Gelechia hallipalpis RILEY, Smith's List Lep. Bor. Am., No. 5394, 1891.

Lord Walsingham is responsible for the synonymy which seems probable from the descriptions. What caused Riley to give Walker's name [misspelled] precedence in his list I do not know, but the species ought to be known as *juucidella* Clemens, as shown by Lord Walsingham.

It is one of the most common Gelechiidae in the vicinity of Washington. Miss Murtfeldt has recorded its food plant as *Ambrosia artemisiifolia*; I have reared large series from this plant, and also from *A. tripartita*, and from *Solidago* and *Aster*. The larva, which is well described by Miss Murtfeldt, folds the edge of the leaf and pupates within the fold. There are at least two generations in the locality of Washington City.

Chambers described his species from Kentucky; Miss Murtfeldt's specimen came from Missouri, and Clemens' specimen presumably from Pennsylvania. In the National Museum are specimens from the following localities: Canada, Kansas, Maine, District of Columbia, Virginia, Maryland, Maine.

TRICHOTAPHE MELANTHERELLA Busck.

- Trichotaphe melantherella* BUSCK, Proc. U. S. Nat. Mus., XXIII, 1900, p. 232, pl. 1, fig. 2; Dyar's List Amer. Lep., No. 5663, 1902.—DYAR, Proc. Ent. Soc. Wash., IV, 1901, p. 472.

Type.—No. 4939, U.S.N.M.

Food plant.—*Melanthera deltoidea*.

Habitat.—Palm Beach, Florida.

TRICHOTAPHE SETOSELLA Clemens.

- Trichotaphe setosella* CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 166; Stainton Ed. N. Am. Tin., 1872, p. 121.—ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 282.—BUSCK, Dyar's List Amer. Lep., No. 5664, 1902.
Gelechia setosella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 147.
Begoe costolutella CHAMBERS, Can. Ent., IV, 1872, p. 209; Can. Ent., IX, 1877, p. 24.
Gelechia (Malacotricha) bilobella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 280, pl. IV, fig. 28, a, b.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 185.
Gelechia bilobella RILEY, Smith's List Lep. Bor. Am., No. 5325, 1891.

The great similarity in coloration and size between the two species, *Trichotaphe setosella* Clemens = *Begoe costolutella* Chambers = *Malaco-*

tricle bilobella Zeller, and *Ypsolophus* (*Nothris*) *eupatoriella* Chambers = *Nothris dolabella* Zeller has very naturally caused some trouble.

A large series of both species is before me. The *Ypsolophus* species I have bred from *Eupatorium* in Washington City, and there can be no doubt but that it represents *eupatoriella* Chambers, nor that this is synonymous with Zeller's *dolabella*, as thought by Lord Walsingham; but I can not agree with his Lordship in placing *setosella* Clemens as synonymous with this species.

Clemens was well acquainted with the genus *Ypsolophus*, and would undoubtedly have placed his species in that genus had it belonged there. His description fits the *Trichotaphe* species better than the other species, and even if there was a doubt it seems reasonable to give Dr. Clemens the benefit thereof, and not remove his species from the genus which he himself had erected and surely should be supposed to know.

Lord Walsingham was led to his conclusions through a specimen labeled *setosella* in C. T. Robinson's collection, but it seems much more natural to suppose that this specimen was wrongly labeled—taking in consideration the great similarity of the two species—than to suppose that Dr. Clemens should not have known an *Ypsolophus* when he saw one, but should have described it wrongly under another—and his own—genus.

Clemens' type is no longer in existence, so absolute proof can not be obtained; but the circumstantial evidence speaks for Zeller's view, that *setosella* is a *Trichotaphe* [*Malachotriche*], as originally described by Clemens.

Habitat.—District of Columbia, Ohio (Zeller), Kentucky (Chambers), Pennsylvania (Clemens). In the U. S. National Museum are specimens from New York and Texas.

TRICHOTAPHE INVERSELLA Zeller.

Epicorthis inversella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 248, pl. III, fig. 13, a, b.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 140; Can. Ent., X, 1878, p. 54; Journ. Cinn. Soc. Nat. Hist., II, 1880, pp. 198, 202, fig. 13.—RILEY, Smith's List Lep. Bor. Am., No. 5559, 1891.

Trichotaphe inversella BUSCK, Dyar's List Amer. Lep., No. 5665, 1902.

I have examined specimens determined by Chambers in the U. S. National Museum and in Professor Fernald's collection; also several other specimens in the National Museum, and in Dr. Dietz's collection, all agreeing with Zeller's type in the Museum of Comparative Zoology, in Cambridge, and with his description and figure.

The difference in labial palpi is only a difference in degree, not in kind, and the species can well be included in *Trichotaphe* on that account.

Zeller writes that veins 7 and 8 in forewing "die Flügelspitze umfasst;" but the apex in this species, as in most of the species belong-

ing to *Trichotaphe*, is not pointed, but rounded. It is a matter of taste where the extreme point is, and it can just as well be said that veins 7 and 8 go to costa, as is characteristic for the entire family *Gelechiidae*.

Chambers' figure of the venation of this species¹ is wrong in several points besides the one in hindwing, corrected by Chambers in the margin of H. Edwards' copy and recorded by Mr. William Bentenmüller.² The form of the wing is not correct, the stalk of veins 2 and 3 in forewings is longer than represented in the figure and vein 8 is omitted.

All the specimens I have met with came from Texas.

TRICHOTAPHE CONDALIAVORELLA Busck.

Trichotaphe condaliavorella Busck, Proc. U. S. Nat. Mus., XXIII, 1900, p. 232; Dyar's List Amer. Lep., No. 5666, 1902.—DYAR, Proc. Ent. Soc. Wash., IV, 1901, p. 473.

Type.—No. 4940, U.S.N.M.

Food plant.—*Condalia ferrea*.

Habitat.—Palm Beach, Florida.

TRICHOTAPHE CHAMBERSELLA Murtfeldt.

Gelechia chambersella MURTFELDT, Can. Ent., VI, 1874, p. 222; Can. Ent., XIII, 1881, p. 242.—CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 240; Bull. U. S. Geol. Surv., IV, 1878, pp. 116, 142.—RILEY, Smith's List Lep. Bor. Am., No. 5336, 1891.

Gelechia inaequepulvella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 239; Bull. U. S. Geol. Surv., IV, 1878, p. 144.—RILEY, Smith's List Lep. Bor. Am., No. 5388, 1891.

Trichotaphe chambersella Busck, Dyar's List Amer. Lep., No. 5667, 1902.

There may be some question as to the right of giving Miss Murtfeldt's name priority; but inasmuch as she certainly had her name in print (though without description of the species) and inasmuch as her biological note on the food plant given at that time really is of quite as much value in recognizing the species as Chambers' mere excuse for a description, I give her name preference, the more so because it surely was Chambers' inexcusable fault that a synonym was made, and because only through Miss Murtfeldt has the species and its synonymy been finally cleared up.

It appears from correspondence I have had with Miss Murtfeldt that she sent the first specimen bred by her to Chambers for determination; that he pronounced it a new species and agreed that Miss Murtfeldt should name it after him; that he thereafter, on the single specimen received from Miss Murtfeldt, made a new species, *inaequepulvella*, forgetting or mistaking the identity of the specimen in such a degree that he, on the very next page, mentions having received such a specimen and compares it with his *ambrosiavella*.

This single original type specimen is still found in Cambridge in

¹Journ. Cinn. Soc. Nat. Hist., II, p. 202, fig. 13.

²Ent. Am., V, p. 37.

poor but recognizable condition, labeled by Chambers *inæquepulvella*, and proving beyond a doubt that it really is Miss Murtfeldt's species.

In Amherst, in Professor Fernald's collection, I have examined Miss Murtfeldt's type, and I have also received identical authenticated specimens from Miss Murtfeldt.

In the U. S. National Museum are, besides these, two identical specimens bred by Mr. Coquillet in Los Angeles, California, from the same food plant as Miss Murtfeldt recorded, *Ambrosia artimisiifolia*. Mr. Coquillet has kindly given me his notes on the larva, which are identical with Miss Murtfeldt's careful description. I have also bred the species from same food-plant in Washington and in Kentucky.

TRICHOTAPHE LACTIFLOSELLA Chambers.

Gelechia lactiflosella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 89, 144.—

RILEY, Smith's List Lep. Bor. Am., No. 5398, 1891.

Trichotaphe lactiflosella BUSCK, Dyar's List Amer. Lep., No. 5668, 1902.

The unique type of this easily recognized, large, light-yellow species was found in the Museum of Comparative Zoology in Cambridge, in good condition, authenticated by Chambers' label and agreeing with his description.

I have taken several specimens of this species this summer at light on Plummers Island in the Potomac River, Maryland.

The type is from Texas.

TRICHOTAPHE TRIMACULELLA Chambers.

Gelechia trimaculella CHAMBERS, Can. Ent., VI, 1874, p. 238; Bull. U. S. Geol.

Surv., IV, 1878, p. 147.—RILEY, Smith's List Lep. Bor. Am., No. 5500, 1891.

Trichotaphe trimaculella BUSCK, Dyar's List Amer. Lep., No. 5669, 1902.

Chambers' type from Miss Murtfeldt's collection, now in Professor Fernald's possession, agrees with his types in Cambridge and with his description.

It is an easily recognized species, of which I have found examples in the unnamed material in the U. S. National Museum.

It is a typical *Trichotaphe* and has a similar very striking counterpart in *Ypsolophus touceyellus* Busek (*Anarsia trimaculella* Chambers) (p. 922), as *Trichotaphe setosella* has in *Ypsolophus eupatoriella* (p. 925).

This recurring specific similarity between species of the two genera is an interesting proof of their near relationship. The species was described from Kentucky; the specimen in the U. S. National Museum came from Texas. I have also taken it at light in District of Columbia.

TRICHOTAPHE BIDISCOMACULELLA Chambers.

Gelechia bidiscomaculella CHAMBERS, Can. Ent., VI, 1874, p. 241; Bull. U. S.

Geol. Surv., IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5324, 1891.

Trichotaphe bidiscomaculella BUSCK, Dyar's List Amer. Lep., No. 5670, 1902.

Chambers described his *Gelechia bidiscomaculella* from a single specimen, with palpi missing, collected in Texas. This type specimen is no longer in existence, and absolute certainty concerning the species is therefore not obtainable.

Chambers says that it is "perhaps a variety of *subrubrella* Chambers," described on the same page, which species, he again writes, is "perhaps a variety of *rufusella* Chambers," and which I, after careful consideration of all the material of *rufusella* [= *Anacamptis fullonella* Zeller, p. 849], had placed as synonym of that species.

It is evident that *bidiscomaculella* must be very similar to this species.

In Professor Fernald's collection is what was supposed to be a type of *Gelechia rufusella*, with label to that effect in Chambers' handwriting. This specimen is from Texas, wherefrom both the above species were described, and it is very similar specifically to *rufusella* (*Anacamptis fullonella*), but belongs to the genus *Trichotaphe*, and could not be *rufusella*, because Chambers expressly emphasizes that this species has the terminal joint of labial palpi longer than second joint, as have also the other types of *rufusella*, while the specimen in Professor Fernald's collection has the terminal joint decidedly shorter than second.

It agrees with Chambers' short description of *Gelechia bidiscomaculella*, and, aside from the difference in the length of labial palpi, differs from *rufusella* in having underside of thorax and legs black, with narrow white annulations on the tarsi. Second joint of palpi is also deep black on the underside except at apex.

I believe this specimen represents *Gelechia bidiscomaculella*, and have consequently referred that species to the present genus.

I know of no other specimens of this species.

TRICHOTAPHE FERNALDELLA, new species.

Trichotaphe fernaldella Busck, Dyar's List Amer. Lep., No. 5671, 1902.

Antennæ dark fuscous with narrow yellow annulations; cilia less than I. Labial palpi long, perfectly smooth, light straw yellow; second joint thickened with appressed scales, terminal joint nearly as long as second. Face, head, and thorax light straw yellow. Forewings more pointed than usual in the genus, light straw yellow with the intervals between the veins slightly deeper colored.

One dark fuscous round dot is on the middle of the cell, another similar one at the end of the cell. Around the apical edge is a thin dark line, and just inside this along the edge of the wing is a row of small dark fuscous dots. Cilia whitish yellow with two indistinct yellowish fuscous lines parallel with the edge of the wing. Hindwings very light whitish straw colored, the edge darker; cilia white.

Abdomen yellowish white. Legs light straw colored without any markings.

Alar expanse.—18 mm.

Habitat.—Orono, Maine.

Type.—No. 6393, U.S.N.M.

Other specimens in Professor Fernald's collection.

The species has a certain general resemblance to *Gelechia petasitis* Pfaffenzeller, with which species it had been confounded in Professor Fernald's collection.

I am glad to name this very distinct species after Professor Fernald, to whom the U. S. National Museum is indebted for the type and to whom the writer is under many obligations for much valuable help kindly extended during these studies.

TRICHOTAPHE? GEORGIELLA Walker.

Depressaria georgiella WALKER, Cat. Lep. Het. Brit. Mus., XXXV, 1866, p. 1827.

Trichotaphe georgiella WALSINGHAM, Proc. Zool. Soc. Lond., 1891, p. 312.—BUSCK, Proc. U. S. Nat. Mus., XXIV, 1902, p. 731; Dyar's List Amer. Lep., No. 5672, 1902.

Walker says in his description of this species:

Second joint of labial palpi with a long tuft at the tip beneath, third joint much longer than second.

Which clearly shows that it can not be a *Trichotaphe*, as suggested by Lord Walsingham; but as I have not recognized the species, type of which is in Lord Walsingham's possession, it must for the present remain in this genus, as he has placed it.

GLYPHIDOCERA Walsingham.

Plate XXXII, fig. 34.

Glyphidocera WALSINGHAM, Proc. Zool. Soc. Lond., 1891, p. 531, pl. xli, fig. 8.

Antennæ slightly serrate and in the males deeply notched on the upper side of the joint next to the basal one; in the females simple, without notch, but the outer end of the basal joint is somewhat enlarged. Maxillary palpi obsolete. Labial palpi long, recurved, smooth, somewhat compressed laterally, sharpened in front; terminal joint pointed, shorter than second joint. Forewing elongate, rounded at apex, slightly arched at extreme base of costa, costal and dorsal edge parallel; 11 veins, vein 8 absent, 7 to costa, 2 and 3 stalked. Hindwings twice as broad as forewings, termen slightly sinuate, 8 veins, 3 and 4 stalked, 6 and 7 stalked.

The notched antennæ in the male are exceptional in the family Gelechiidae, and found only in this and in the following genus; they are exactly similar to the antennæ found in some of the Blastobasidae.

Lord Walsingham placed this genus in Xyloryetidae, but it falls naturally in the present family.

The two recognized American species of this genus may easily be

separated by the characters given below. I have met with two other species of this genus, but have not sufficient good material to describe them.

With face, head, and thorax dark fuscous*floridanella*, p. 917.
 With face, head, and thorax light ochreous.....*xquepulella*, p. 917.

GLYPHIDOCERA FLORIDANELLA Busck.

Glyphidocera floridanella BUSCK, Proc. Ent. Soc. Washington, IV, 1901, p. 474;
 Dyar's List Amer. Lep., No. 5673, 1902.

Type.—No. 5663, U.S.N.M.

Habitat.—Palm Beach, Florida.

GLYPHIDOCERA ÆQUEPULVELLA Chambers.

Gelechia xquepulella CHAMBERS, Can. Ent., IV, 1872, p. 192; Can. Ent., VI, 1874, p. 230; Cinn. Quart. Journ., II, 1875, p. 246; Bull. U. S. Geol. Surv., III, 1877, pp. 125, 141; IV, 1878, p. 141.—RILEY, Smith's List Lep. Bor. Am., No. 5300, 1891.

Glyphidocera xquepulella BUSCK, Proc. Ent. Soc. Wash., IV, 1901, p. 475; Dyar's List Amer. Lep., No. 5674, 1902.

In the Museum of Comparative Zoology in Cambridge was found 11 specimens labeled by Chambers *Gelechia xquepulella* and agreeing with his description.

They unquestionably represent this species and show that it belongs to the present interesting genus.

I have met with only one other specimen in U. S. National Museum, from Texas, probably received from Chambers, who also recorded the species from Kentucky, Colorado, and California.

ANORTHOSIA Clemens.

Plate XXXII, fig. 35.

Anorthosia CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 156.

Sagaritis CHAMBERS, Can. Ent., IV, 1872, p. 225.

Antennæ in male with deep notch above near base like in the preceding genus; in female simple, without the notch. Labial palpi with second joint clothed beneath with porrected appressed long stiff hairs, above with large expansible tuft of hairs; terminal joint erect, slender, pointed. Forewings elongate, narrow, pointed; 12 veins, 7 and 8 stalked to costa, 2 and 3 stalked. Hindwings narrower than forewings, pointed, termen sinuate below apex; 8 veins, 3 and 4 connate, 5 approximate to 4, 6 and 7 connate, transverse vein nearly obsolete between 5 and 6.

Clemens says in his description and shows in his figure that terminal joint of labial palpi is emitted from apical third of second joint, while it in reality is emitted from the end of second joint proper, as denuding shows, and only look otherwise on account of the protruding hairs on the underside.

Strangely enough neither Clemens nor Lord Walsingham observed the striking antennal structure in the male; Clemens' figure of the antennæ is that of the female.

Lord Walsingham writes¹ that veins 3 and 4 in hindwing are separate in *Anorthosia*. This is a mistake and in variance with Clemens' description and figure as well as with specimens of *Anorthosia punctipennella*, undoubtedly correctly determined by Lord Walsingham in the collections of U. S. National Museum, Dr. Dietz, Professor Fernald, and in the Philadelphia Academy of Natural Sciences, bearing Walsingham's blue labels No. 319, 327, and others.

And if *Anorthosia straminis* Walsingham, described from Africa, has the alleged venation it can not properly be included in this genus.

Of Chambers' genus *Sagaritis* no authentic material exists, but his description leads me to believe that it must be identical with *Anorthosia*, though several minor details of his figure of the venation differ from the true venation of *Anorthosia*; but nearly all of Chambers' delineations are more or less incorrect and can not be depended upon.

I am so fortunate as to have my opinion corroborated by Lord Walsingham, who independently concluded that *Sagaritis* was synonymous with *Anorthosia*, but still this question will be open to doubt until we know the American fauna much more intimately than we do now.

Only the two species are included, and I feel rather confident that Chambers' species is even specifically identical with *Anorthosia punctipennella*, and can not, from his short description, choose any differences from that species which may not be omissions caused by an imperfect specimen used as type; but at present I think it more proper and safe to retain *gracilella* as a distinct species until further knowledge of our fauna is obtained.

ANORTHOSIA PUNCTIPENNELLA Clemens.

Anorthosia punctipennella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 15; Stainton Ed. N. Am. Tit., 1872, p. iii.—CHAMBERS, Can. Ent., IV, 1872, p. 225; VI, 1874, p. 245.—WALSINGHAM, Trans. Ent. Soc. Lond., 1891, p. 110.—RILEY, Smith's List Lep. Bor. Am., No. 5522, 1891.—BUSCK, Dyar's List, Amer. Lep., No. 5675, 1902.

Clemens's type is lost, but there is no difficulty in identifying this peculiar species. I have examined many specimens determined by Lord Walsingham, who had seen Clemens' original specimen, and I have repeatedly taken this species in the vicinity of Washington.

The highly specialized palpi give the insect a peculiar bearded appearance when it is excited and spreads the long hairs out laterally on each side of the face. The early stages are not known.

Habitat.—Eastern United States.

¹Trans. Ent. Soc. Lond., 1891, p. 110.

ANORTHOSIA GRACILELLA Chambers.

Sagaritis gracilella CHAMBERS, Can. Ent., IV, 1874, p. 226; Bull. U. S. Geol. Surv., IV, 1878, p. 162.—RILEY, Smith's List Lep. Bor. Am., No. 5544, 1891.
Anorthosia gracilella, BUSCK, Dyar's List Amer. Lep., No. 5676, 1902.

The species is unknown to me if it does not eventually prove the same as the foregoing, when it is found that the description can not be applied to any other Gelechiid.

Habitat.—Kentucky.

ENCHRYSA Zeller.

Enchrysa ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 282.

I am not personally acquainted with this genus except from Zeller's description and figure and from the following notes kindly sent me by Mr. J. Hartley Durrant on the unique type in Lord Walsingham's collection.

As Zeller's generic description and figure certainly must be incorrect, I have relied exclusively on the notes on the type, which are as follows:

Type minus abdomen and one hindwing and the whole insect rickety. I found this very difficult to study, fearing it would fall to pieces at the least jar. It is a very distinct thing; you will know it at once if you see a specimen. Antennæ dentate, palpi smooth, terminal joint distinctly shorter than median. Forewings impressed on costa toward apex; 12 veins, 7 and 8 stalked, 7 to immediately above apex, 3 from before angle of cell. Hindwings elongate, widening outward; apex pointed, produced; termen excavate beneath apex, slightly emarginate above tornus; 8 veins, 3, 4, and 5 remote, nearly parallel, 7 and 8 remote. Very close to *Aristotelia*, from which I think it is perhaps separable, but I have had great difficulty in studying the type. Zeller's figure satisfactory so far as it goes. I dare not trust this specimen to the post; it would certainly fall all to pieces.

I have placed this genus, following Zeller, next to *Ypsolophus*, but it does seem evident that it is much nearer *Aristotelia*, as Mr. Durrant writes.

Only the one species has been described.

ENCHRYSA DISSECTELLA Zeller.

Enchrysa dissectella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 283, pl. IV, fig. 29ab.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 140.—RILEY, Smith's List Lep. Bor. Am., No. 5593, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5677, 1902.

The unique type is in the Walsingham's collection. It was described from Ohio.

No other specimen has been recognized, but it must be a striking little animal, and should be recognized from Zeller's figure and description without any difficulty.

YPSOLOPHUS Fabricius.

Ypsolophus FABRICIUS, Supplementum Ent. Syst., Hafniae, 1798, p. 421, pl. xxxvi.

Labial palpi long curved, second joint thickened, with dense projecting tuft of long hairs beneath, sometimes rough above; terminal as long or longer than second, slender pointed.

Forewings with 12 veins, 7 and 8 stalked, 2 and 3 stalked; hindwings as broad or broader than forewings, trapezoidal apex obtusely pointed, termen slightly sinuate; 8 veins, 3 and 4 connate or stalked, 5 approximate to 4, 6 and 7 closely approximate, connate or stalked.

Mr. E. Meyrick made *Nothris* Hübner synonymous with *Ypsolophus*,¹ and the species hitherto placed in that genus in America, which are known to me, conform well with the definition of *Ypsolophus*, except *Nothris maligemmella* Murtfeldt, which is a Blastobasid, lately referred to the genus *Holcocera* Clemens,² and *Ypsolophus trimaculellus* Fitch, which has been discovered to belong to the family Cécophoridae and has been made the type of a new genus *Eumeyrickia* Busck.³

The other species probably belong in the present genus, but unfortunately some of them are known only from the descriptions, all authentic material being lost.

By continued breeding of good series of *Ypsolophus*, however, all of them may in time be rediscovered, but at present it is not safe from the more or less meager descriptions to even include them in the following table, which then only contains such species as are recognized at present.

Hindwings bluish, iridescent semitransparent.....	<i>ligulellus</i> , p. 921
Hindwings not so.....	1
1. Forewings with dark dorsal spot at apical third.....	<i>citrijoliellus</i> , p. 923
Forewings without such spot.....	2
2. Forewings with large black spot on disk.....	<i>aequatoriellus</i> , p. 925
Forewings without large spot on disk.....	3
3. Forewings with distinct discal spots.....	4
Forewings without distinct discal spots.....	<i>caryofoliellus</i> , p. 923
4. Discal spots light brown.....	<i>punctidiscellus</i> , p. 922
Discal spots not light brown.....	5
5. With no white scales in discal spots.....	6
With white scales in discal spots.....	7
6. With apical row of black dots.....	<i>bipunctellus</i> , p. 923
Without such row of apical dots.....	<i>touceyellus</i> , p. 922
7. White part of discal spots large, prominent.....	<i>trinotellus</i> , p. 923
White part of discal spots small, not prominent.....	<i>ventrellus</i> , p. 924
Not included in synoptic table: <i>malifoliellus</i> , p. 925; <i>quercicellus</i> , p. 926; <i>roseocostellus</i> , p. 926; <i>bimaculellus</i> , p. 926; <i>grisseellus</i> , p. 927; <i>rusticus</i> , p. 927.	

¹ Trans. Ent. Soc. Lond., 1887, p. 274.

² Journ. New York Ent. Soc., X, 1902, p. 96.

³ Journ. N. Y. Ent. Soc., X, 1902, p. 94.

YPSOLOPHUS LIGULELLUS Hübner.

- Dichomeris ligulella* HÜBNER, Zuträge exot. Schmett, 1818, p. 70, figs. 143, 144.
Rhinoceera pometella HARRIS, Cambridge Cron., July 17, 1853.
Chatochilus pometellus FITCH, Journ. N. Y. State Agr. Soc., IV, 1853, p. 36; Trans. N. Y. State Agr. Soc., XIII, 1854, p. 178.
Ypsolophus pometellus CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 166.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 186.—RILEY, Smith's List Lep. Bor. Am., No. 5527, 1891.—DIETZ, Smith's List Ins. New Jersey, 1900, p. 475.—SLINGERLAND, Cornell Univ. Agr. Exp. Sta. Bull., 1901, p. 187.
Chatochilus contubernatellus FITCH, Journ. N. Y. State Agr. Soc., IV, 1853, p. 36; Trans. N. Y. State Agr. Soc., XIII, 1854, p. 178.
Ypsolophus contubernatellus RILEY, Smith's List Lep. Bor. Am., No. 5525, 1891.
Ypsolophus pauciguttellus CLEMENS; Proc. Ent. Soc. Phila., II, 1863, p. 123; Stainton Ed. Tin. N. Am., 1872, p. 228.—ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 283.
Ypsolophus flavivittellus CLEMENS, Proc. Ent. Soc. Phila., II, 1863, p. 429; Stainton Ed. Tin. N. Am., 1872, p. 254.
Ypsolophus recdella CHAMBERS, Can. Ent., IV, 1872, p. 222.
Ypsolophus rudereella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 167.
Ypsolophus quercipomonella CHAMBERS, Can. Ent., IV, 1872, p. 222.—PACKARD, Rep. U. S. Ent. Comm., V., 1890, p. 202.
Ypsolophus ligulellus BUSCK, Dyar's List Amer. Lep., No. 5678, 1902.

In the U. S. National Museum are Fitch's types of *pometellus* and *contubernatellus*, and specimens labeled by Lord Walsingham (blue labels No. 666, 1195, 1222, and 1223); *pauciguttellus*, *pometellus*, *flavivittellus*, and *contubernatellus* = *quercipomonellus* = *flavivittellus*.

There are besides many specimens reared from oak and from apple in the insectary of the U. S. Department of Agriculture and also specimens from New York (Beutenmüller); Missouri (Murtfeldt); Georgia, from live oak (Schwarz); Kansas (Crèvecoeur); Pennsylvania (Heidemann); West Virginia (bred from oak); District of Columbia and Maryland (Busek). I have also determined specimens from New Jersey (Kearfott) and from New Mexico (Cockerell).

As the consensus of authorities is that Hübner's figures represent this species (the variety *flavivittellus* Clemens) and as additional evidence for or against this view can not be forthcoming, it seems rational to adopt Hübner's name instead of continuing to use the query.

Lord Walsingham is responsible for the entire synonymy¹ which Zeller already had indicated in part, and it must stand until disproved, the more so as new and careful observations by Mr. Slingerland, who has lately treated this insect very interestingly and exhaustively, seem to confirm it. But Lord Walsingham expresses a doubt, and it does seem to me likely, that at least two distinct species will be ultimately found to have been mixed up, one feeding on oak and one on apple.

From the material at my command at present, however, though quite large, no conclusions can be made, and I am unable to separate

¹Trans. Am. Ent. Soc. Phila., X, p. 186.

the imagoes according to food plant therefrom, it being too scant and too uncertainly labeled. Most careful observations of the larva from both food plants with this object in view are necessary to clear up the question.

YPSOLOPHUS PUNCTIDISCELLUS Clemens.

Ypsolophus punctidiscellus CLEMENS, Proc. Ent. Soc. Phila., II, 1863, p. 123; Stainton Ed. Tin. N. Am., 1872, p. 228.—ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 285.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 166.—RILEY, Smith's List Lep. Bor. Am., No. 5528, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5679, 1902.

Ypsolophus stramineellus CHAMBERS, Can. Ent., IV, 1872, p. 224; Bull. U. S. Geol. Surv., IV, 1878, p. 167.—RILEY, Smith's List Lep. Bor. Am., No. 5531, 1891.

A perfect specimen in the National Museum labeled "Boll. Texas," was determined by Lord Walsingham; it agrees perfectly with the description and undoubtedly represents this species, type of which, like the majority of Clemens' types, is lost.

I have several fine specimens collected in New Jersey by Mr. Kearfott and in the District of Columbia by myself. The species comes freely to light.

Chambers' description of *stramineellus*, of which no type is in existence, seems to warrant the synonym with Clemens' species, as suggested by Chambers himself.

YPSOLOPHUS TOUCEYELLUS Busck.

Anarsia trimaculella CHAMBERS, Can. Ent., VI, 1872, p. 243; Bull. U. S. Geol. Surv., IV, 1878, pp. 92, 129.—WALSINGHAM, Proc. Zool. Soc. Lond., 1891, p. 526.—RILEY, Smith's List Lep. Bor. Am., No. 5539, 1891.

Ypsolophus touceyellus BUSCK, Dyar's List Amer. Lep., No. 5680, 1902.

Renamed after the author, Victor Toucey Chambers.

By transferring this species to its proper genus the name *trimaculella* becomes preoccupied by *Ypsolophus* [*Chetochilus*] *trimaculellus* although, as I have shown, this is not an *Ypsolophus*, nor even a *Gelechiid*, but an *Ecophorid*, forming a new genus, *Eumeyrickia* Busck.¹

I have compared Chambers' type (no. 470) of *Anarsia trimaculella* in the U. S. National Museum and found it identical with a specimen in Cambridge Museum labeled by Chambers. This specimen was formerly the property of the Peabody Institute in Salem, Massachusetts, and bears Lord Walsingham's blue label no. 994, corresponding to his determination in his handwritten notebook: *Anarsia trimaculella* Chambers.

The National Museum specimen is Chambers' true type from Texas, while the Cambridge specimen is his later example from Kentucky.

The species is a true *Ypsolophus*. I have met with no other specimens.

¹Journ. N. Y. Ent. Soc., X, 1902, p. 94.

YPSOLOPHUS BIPUNCTELLUS Walsingham.

Ypsolophus bipunctellus WALSINGHAM, Trans. Amer. Ent. Soc. Phila., X, 1886, p. 186.—RILEY, Smith's List Lep. Bor. Am., No. 5523, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5681, 1902.

The type of this species is in Professor Fernald's collection, where I have examined it; identical specimen from Nantucket Island, Massachusetts, is in the U. S. National Museum. (Ac. No. 34727.)

YPSOLOPHUS TRINOTELLUS Coquillett.

Nothris trinotella COQUILLET, Papilio, III, 1883, p. 81.—PACKARD, Rep. U. S. Ent. Comm., V, 1890, p. 640.

Ypsolophus trinotellus BUSCK, Dyar's List Amer. Lep., No. 5682, 1902.

Type of this very distinct species is in Professor Fernald's collection in very poor condition, consisting of head, thorax, and one forewing. The species is, however, different from all others described, and easily recognized from the description.

Food plant.—Hazel.

Habitat.—Illinois.

YPSOLOPHUS CITRIFOLIELLUS Chambers.

Nothris citrifoliella CHAMBERS, Journ. Cinn. Soc. Nat. Hist., II, 1880, p. 184.—COMSTOCK, Rep. U. S. Dept. of Agr., 1880, p. 205.—RILEY, Smith's List Lep. Bor. Am., No. 5536, 1891.

Ypsolophus citrifoliellus BUSCK, Dyar's List Amer. Lep., No. 5683, 1902.

The original bred series from which Chambers described this species is still in U. S. National Museum in fine condition.

It is a very distinct, easily recognized species.

Food plant.—Orange.

Habitat.—Florida.

YPSOLOPHUS CARYÆFOLIELLUS, Chambers.

Ypsolophus caryæfoliella CHAMBERS, Can. Ent., IV, 1872, p. 224; Bull. U. S. Geol. Surv., IV, 1878, p. 166.

Ypsolophus caryæfoliellus RILEY, Smith's List Lep. Bor. Am., No. 5524, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5684, 1902.

A specimen in the U. S. National Museum determined by Lord Walsingham agrees well with Chambers' description (except that its alar expanse is 23 mm., not as Chambers' type, 21 mm.), and undoubtedly represents this species; it is from Miss Murtfeldt, Missouri. There is also a specimen from Texas (Beutenmüller). The species was described from Kentucky.

According to Chambers the larva is green, with six narrow, longitudinal, interrupted white lines; head ferruginous, first thoracic segment brown, thoracic feet black. At maturity it becomes white, suffused with pink, and with the longitudinal lines deep pink.

Food plant.—*Carya alba*.

YPSOLOPHUS VENTRELLUS Fitch.

Chatochilus ventrellus FITCH, Trans. N. Y. State Agr. Soc., XIII, 1854, p. 234.

Ypsolophus ventrellus CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 167.—RILEY, Smith's List Lep. Bor. Am., No. 5534, 1891.—BUSCK, Dyar's List. Amer. Lep., No. 5685, 1902.

Ypsolophus unicipunctellus CLEMENS, Proc. Ent. Soc. Phila., II, 1860, p. 125; Stainton Ed. Tin. N. Am., 1872, p. 229.—ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 286.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 167.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 186.—RILEY, Smith's List Lep. Bor. Am., No. 5533, 1891.

Clemens' type of this species is lost, but in the U. S. National Museum are three specimens agreeing well with the description and determined as *unicipunctella* Clemens by Lord Walsingham, who has examined Clemens' type. These specimens undoubtedly represent Clemens' species; they are identical with Fitch's type of *ventrellus*, which was found with his large handwritten label in his collection now in U. S. National Museum.

There is also a series of bred specimens of this species. They bear the label of U. S. Department Agriculture, no. 242, and the following are Professor Riley's unpublished notes on the larva:

Found at Glenwood, Mo., folding up the leaves of the black oak in little tubes. Length, 0.60 of an inch. A striped white and black worm with a redbrown head and cervical shield. Considering the ground color as white, there is a black dorsal line, somewhat restricted at the joints, and on each side of the dorsum is another somewhat wavy line separated from a lateral broader one only by a fine white line. Outer edge along stigmata white and underneath black glaucous.

Piliferous spots above quite large, black with a white annulation; two of them situated in black wavy line and one on lateral black line just above stigmata. Stigmata small, with a smaller piliferous spot just below it and others on venter. First segment dark brown below cervical shield; second segment darker than the others, with a white anterior edge. Last two segments almost entirely black above, being sharply separated from anus and anal prolegs, which are of a very light yellow color. Feet black, abdominal prolegs same as venter. Single white hairs from each spot.

On June 2, one changed to chrysalis. The chrysalis is formed within the leaf, the caterpillar first lining it with white silk.

The chrysalis averages 0.38 inch in length, with the abdomen comparatively narrow and small compared with the anterior half, the extremity tapering to a single point, of normal color, but characterized especially by having about six pairs of little elevations on the dorsum just behind the thorax and three others on each side of them along the upper edge of the wing sheets. Moth issued June 15-22.

The notes continue:

Zeller says it is the same as a variable, often lighter brown-spotted species, which he has often received from Ohio.¹

This bred series shows the extremes of the different ground colors, which Zeller mentions and proves his assertion that the species is variable in ground color from a very light yellow brown to a dark purplish brown.

¹ Riley, Notebook, IV, pp. 29-30.

YPSOLOPHUS EUPATORIELLUS Chambers.

Ypsolophus eupatoriella CHAMBERS, Can. Ent., IV, 1872, p. 221.

Nothris eupatoriella CHAMBERS, Can. Ent., IX, 1877, p. 23; Bull. U. S. Geol. Surv., IV, 1878, p. 158.

Nothris dolabella ZELLER, Verh. k. k. zool.-bot. Gesell. Wien, XXIII, 1873, p. 288.

Nothris setosella WALSHINGHAM (not Clemens), Trans. Ent. Soc. Phila., 1882, p. 188.—RILEY, Smith's List Lep. Bor. Am., No. 5558, 1891.

Ypsolophus eupatoriellus BUSCK, Dyar's List Amer. Lep., No. 5686, 1902.

As explained previously (p. 911), it seems to me unwarranted to make *Trichotaphe setosella* Clemens a synonym of this species. Lord Walshingham, who made it so, did not have Clemens' type, but came to a conclusion from a specimen in C. T. Robinson's collection, labeled *setosella*. It seems more reasonable to believe this specimen wrongly labeled and to accept Clemens' word, that his *setosella* is a *Trichotaphe* species.

I have bred good series of the present species from *Eupatorium* in the District of Columbia, and in U. S. National Museum are besides specimens from the following localities: Florida (Dyar), Texas (Beutenmüller), Arizona (Schwarz), Kansas (Crevecoeur), New York (Banks), Virginia and Maryland (Busck).

The males of this species have an interesting secondary sexual character, which I have not noticed in any other Gelechiid, namely, a strong pencil of long yellow hairs on thorax just below costal base of fore wings. This pencil can be expanded into a whorl of hairs which envelops the eyes and base of the palpi as a veil.

If—what is to be presumed—this pencil in the male is thus expanded during courtship, the insect may indeed be said to have reached in this respect the standpoint of man, whom love makes blind.

The larva feeds in a leaf folded from the edge and pupates within the fold. When full grown it is about 15 mm. long, cylindrical, tapering slightly. Head polished, jet black, longer than wide, semihorizontal, mouth parts brownish. Width of head, 1 mm.

Thoracic shield polished black, straight in front, rounded posteriorly, twice as wide as long. The rest of the body is greenish white, turning at maturity to wine red with white veins; tubercles small, black, hairs short black, anal plate only slightly cornified, light brown. Legs normal, first thoracic feet black, the others whitish; abdominal prolegs with complete circle of small hooks.

Two generations, at least, are found in the locality of Washington, the imagoes issuing in July and late in September.

YPSOLOPHUS MALIFOLIELLUS Fitch.

Chatochilus malifoliellus FITCH, Trans. N. Y. State Agr. Soc., XIII, 1854, p. 231.

Ypsolophus malifoliellus CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 166.—RILEY, Smith's List Lep. Bor. Am., No. 5526, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5687, 1903.

I have not recognized this species, which, as Fitch himself surmised, very likely is only one of the many varieties of *ligulellus*.

There is in the U. S. National Museum, under type No. 469, a specimen (one forewing only!) recorded as collected by and received from Fitch as type of *malifoliella* and bearing a label presumably in Fitch's writing, "*Depressaria malifoliella*."

This forewing can not be made to agree with Fitch's description of *Ypsolophus malifoliellus*, and is probably the type of one of Fitch's many manuscript species. It is a wing of *Machimia tentoriferella* Clemens and has no connection with the present species.

YPSOLOPHUS QUERCIELLUS Chambers.

Ypsolophus quercicella CHAMBERS, Can. Ent., IV, 1872, p. 223; Bull. U. S. Geol. Surv., IV, 1878, p. 83; Journ. Cinn. Soc. Nat. Hist., II, 1880, p. 202, fig. 16.—WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 186.

Ypsolophus quercicella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 167.

Ypsolophus quercicellus RILEY, Smith's List Lep. Bor. Am., No. 5529, 1891.

Ypsolophus quercicellus BUSCK, Dyar's List Amer. Lep., No. 5688, 1902.

The type of the species was lost and no authentic specimen is now in existence. Chambers suggested that it probably rather should be placed under *Depressaria*, but his delineation of the venation shows, if it can be relied upon, that it can not be a *Depressaria*, and provisionally, at least, it must be retained in *Ypsolophus*.

From the fact that it was bred from oak, and that a description, even if meager, was given of the larva, there is some hope of rediscovering the species in time.

Habitat.—Kentucky.

YPSOLOPHUS ROSEOCOSTELLUS Walsingham.

Ypsolophus roseocostellus WALSINGHAM, Trans. Am. Ent. Soc. Phila., X, 1882, p. 185.—RILEY, Smith's List Lep. Bor. Am., No. 5530, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5689, 1902.

I am not acquainted with this species, which for some reason I failed to get notes on while in Amherst, where the type is found in Professor Fernald's collection.

In the U. S. National Museum is a specimen labeled in Walsingham's handwriting *Y. roseocostellus*, but there must be some mistake, as it does not agree with his description, and belongs to *Ypsolophus ventrellus* Fitch, a much larger and more broad-winged species.

YPSOLOPHUS BIMACULELLUS Chambers.

Nothris bimaculella CHAMBERS, Bull. U. S. Geol. Surv., III, 1877, p. 122; Journ. Cinn. Soc. Nat. Hist., II, 1880, p. 184.—RILEY, Smith's List Lep. Bor. Am., No. 5535, 1891.

Ypsolophus bimaculellus BUSCK, Dyar's List Amer. Lep., No. 5690, 1902.

The type of this species is in the Cambridge Museum of Comparative Zoology, but it is in so miserable a condition that it can not be identified specifically. It is, however, a true *Ypsolophus*, as the description would indicate.

YPSOLOPHUS GRISSEELLUS Chambers.

Nothris grisseella CHAMBERS, Can. Ent., VI, 1874, p. 245; Bull. U. S. Geol. Surv., IV, 1878, p. 158.—RILEY, Smith's List Lep. Bor. Am., No. 5537, 1891.
Ypsolophus grisseellus BUSCK, Dyar's List Amer. Lep., No. 5691, 1902.

Described from a single specimen now not in existence.

I have not recognized the species from the description, and it must remain at present as a doubtful species.

YPSOLOPHUS RUSTICUS Walsingham.

Ypsolophus rusticus WALSINGHAM, Proc. Zool. Soc. Lond., 1891, p. 525; 1897, p. 86.—BUSCK, Dyar's List Amer. Lep., No. 5692, 1902.

This species was described from St. Vincent Island, West Indies, and was recorded by Lord Walsingham from Texas.

The slight differences, which Lord Walsingham pointed out, from *Ypsolophus touceyellus* (*Anarsia trimaculellus* Chambers), to which species Walsingham originally had referred his specimen, do hardly seem to hold, and likely it will be found synonymous with that species.

Until large bred series of Chambers' species is obtained and definite proof found to the opposite, *rusticus* must however be retained as a separate species.

Mr. J. Hardley Durrant wrote me (letter of May 10, 1901) about this species as follows:

We have one specimen named *Anarsia trimaculella* Chambers. It is in poor condition and is extremely similar to *Ypsolophus rusticus*. It appears, however, to belong to the genus *Begöë* Chambers=*Malacotricha* Zeller. I might have thought that it was *rusticus*, with denuded palpi, but the shape of the wings seems different, and the male genitalia strongly suggest *Begöë*. The whole question hinges on whether the differences are constant. I gather that you [the writer] have not sufficient material to decide this, nor have we. It would therefore be wiser to leave them as distinct, with a note under each that if they varied they should be united, when naturally *rusticus* will stand. Meanwhile your new name for *trimaculellus* Chambers, is unobjectionable.

It seems highly probable that Lord Walsingham's supposed specimen of *Anarsia trimaculella* is the very similar *Gelechia trimaculella* Chambers, which is a *Trichotaphe* (*Begöë*) (p. 914), and not the present species, and consequently still more reasonable that *rusticus* is equal *touceyellus* (*trimaculella* Chambers), which name it eventually must suppress. But to avoid more confusion it is safest to retain the two names until comparison of specimens can be obtained.

ANARSIA Zeller.

Plate XXXII, fig. 37.

Anarsia ZELLER, Isis, 1839, p. 190.

Second joint of labial palpi with dense projecting tuft beneath; terminal joint in male very short, concealed; in female, long, exposed.

Forewings elongate pointed; 12 veins, 7 and 8 stalked, 6 out of base of 7. Hindwings as broad as forewings; apex pointed, termen slightly sinuate; 8 veins, 3 and 4 connate, 5 approximate to 4, 6 and 7 stalked.

Of the four species included under this genus in Riley's list, *trimaculella* has just been treated under *Ypsolophus* [p. 922], and *belfragesella* Chambers was found to be synonymous with *Leuce fuscocristatella* Chambers [p. 794]. One other of Chambers' species described under the generic name *Anarsia*, namely, *albapulvella*, has been found to be an Oecophorid equal to *Chimabache haustellata* Walsingham, now known under the name *Eumeyrickia trimaculella* Fitch,¹ consequently we can not be very confident about Chambers' understanding of the genus *Anarsia*, and his last species *suffusella*, type of which is lost and which has not been rediscovered as yet from his description, is retained in the present genus simply because it can not be placed anywhere else at the present time, but it will quite surely be found not to belong in this genus. I have, therefore, not made any table for the separation of this and the only true *Anarsia* of which we are sure in this country, *lineatella* Zeller.

ANARSIA LINEATELLA Zeller.

Anarsia lineatella ZELLER, Isis, 1839, p. 190.—STAUDINGER and REBEL, Cat. Lep. Eur., II, No. 2999, 1901.—CHAMBERS, Can. Ent., IV, 1872, p. 208; Bull. U. S. Geol. Surv., IV, 1878, p. 129.—RILEY, Smith's List Lep. Bor. Am., No. 5540, 1891.—DIETZ, Smith's List Ins. N. Jersey, 1900, p. 475.—BUSCK, Dyar's List Amer. Lep., No. 5693, 1902.

Anarsia pruniella CLEMENS, Proc. Acad. Nat. Sci. Phila., 1860, p. 169; Stainton Ed. N. Am. Tin., 1872, pp. 36, 128.—CHAMBERS, Can. Ent., IV, 1872, p. 208; Can. Ent., VI, 1874, p. 243.

This common insect is at times of some economic importance owing to the injury of its larva to peaches and plums. The most commonly observed damages is to the young shoots which the larva enters and kills, but the injury to the fruit itself is sometimes quite as aggravating, as in a case in the District of Columbia which was under the writer's observation in the summer of 1901, where the larvæ occurred in such numbers as to spoil for market purposes nearly the entire large crop of beautiful, nearly ripe peaches. In nearly every one was found the larva, which had eaten into the stone and left the adjoining parts tunnelled and filled with its unappetizing frass.

¹ Journ. N. Y. Ent. Soc., p. 94.

References to the large economic literature has not been attempted; they may be found in part in the comprehensive article on this insect by Mr. C. L. Marlatt.¹

ANARSIA SUFFUSELLA Chambers.

Anarsia suffusella CHAMBERS, Can. Ent., VI, 1874, p. 243; Bull. U. S. Geol. Surv., IV, 1878, p. 129.—RILEY, Smith's List Lep. Bor. Am., No. 5541, 1891.—BUSCK, Dyar's List Amer. Lep., No. 5694, 1902.

This insect, which was described from Texas, will in my judgment be found to be a species of *Ypsolophus* when it is rediscovered.

No authentic material is existent and I have not recognized it as yet from Chambers' description.

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¹U. S. Dept. Agricult., Div. of Entom., Bull. 10, new series, 1898, p. 7.

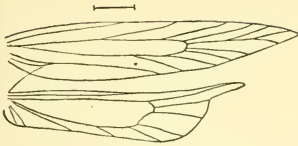
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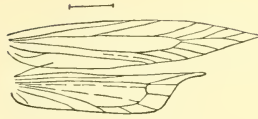
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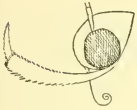
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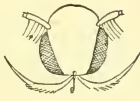
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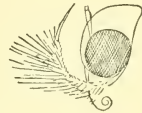
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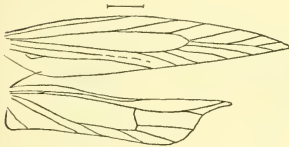
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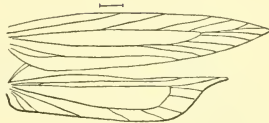
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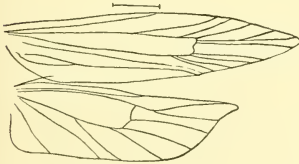
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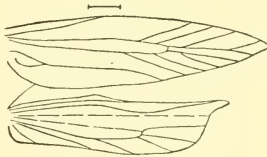
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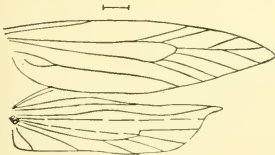
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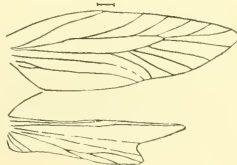
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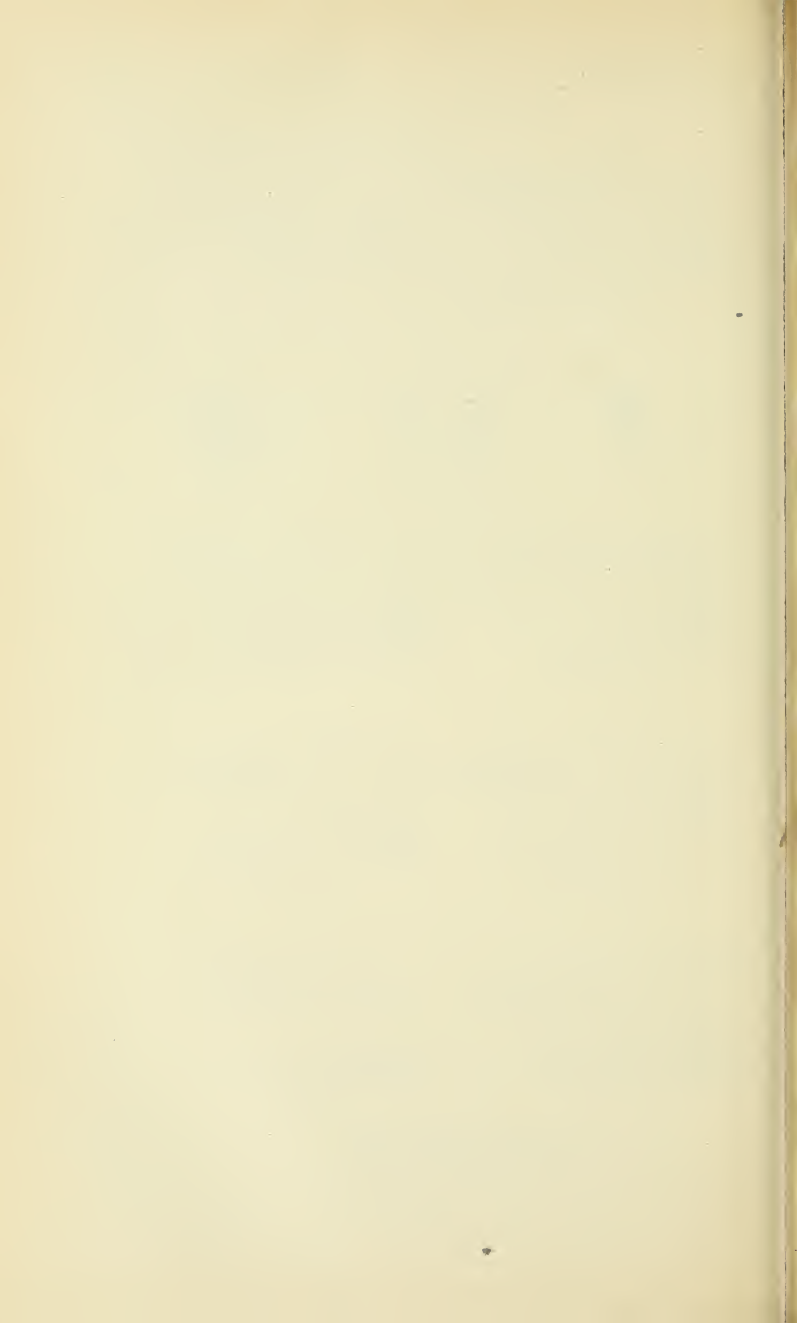
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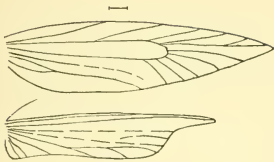


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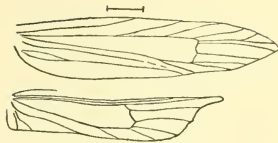
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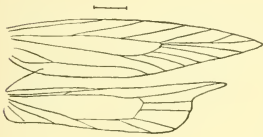




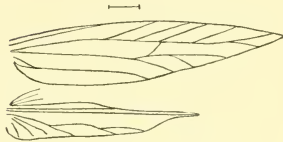
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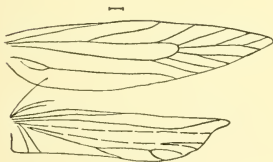
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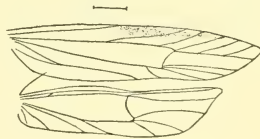
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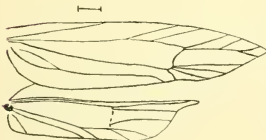
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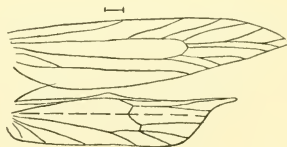
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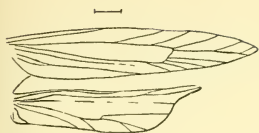
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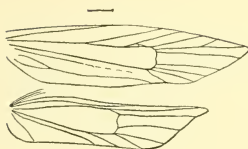
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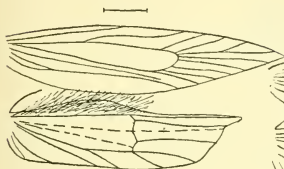
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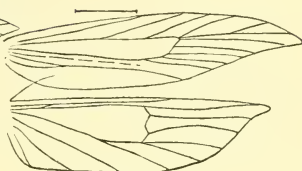
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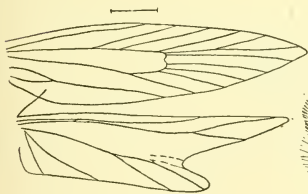
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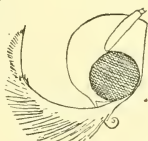
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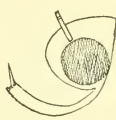
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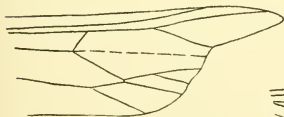
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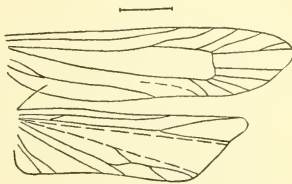
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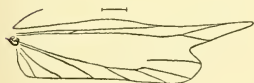
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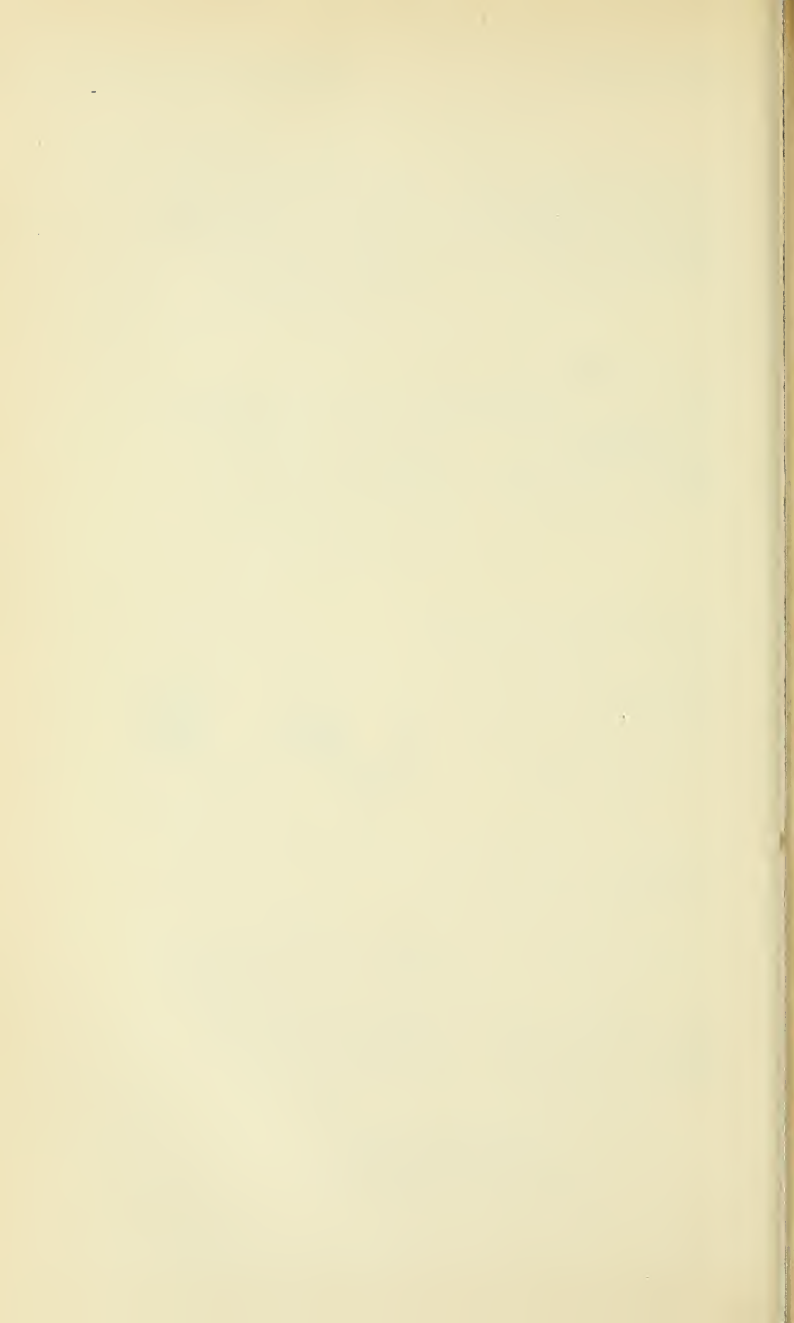
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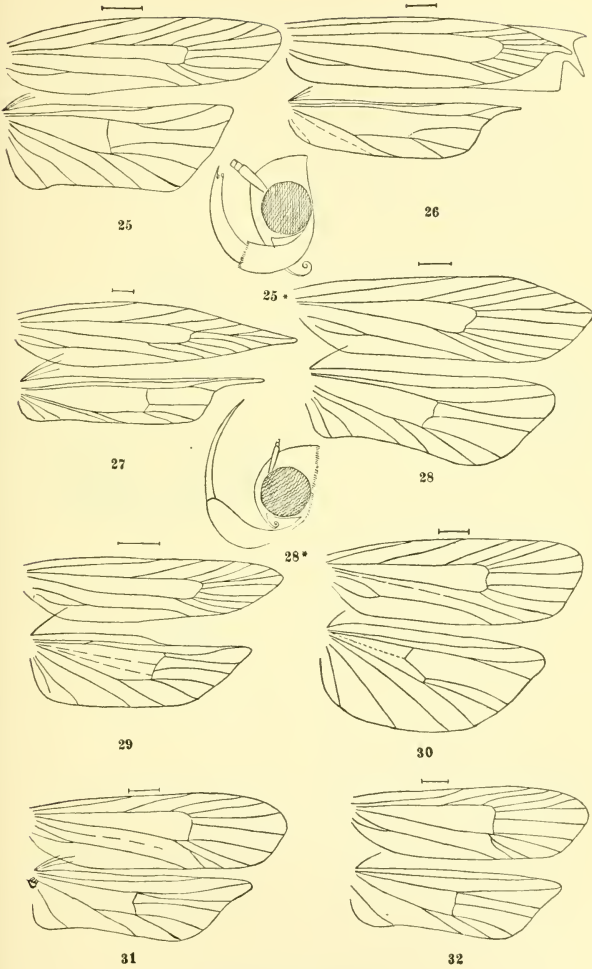


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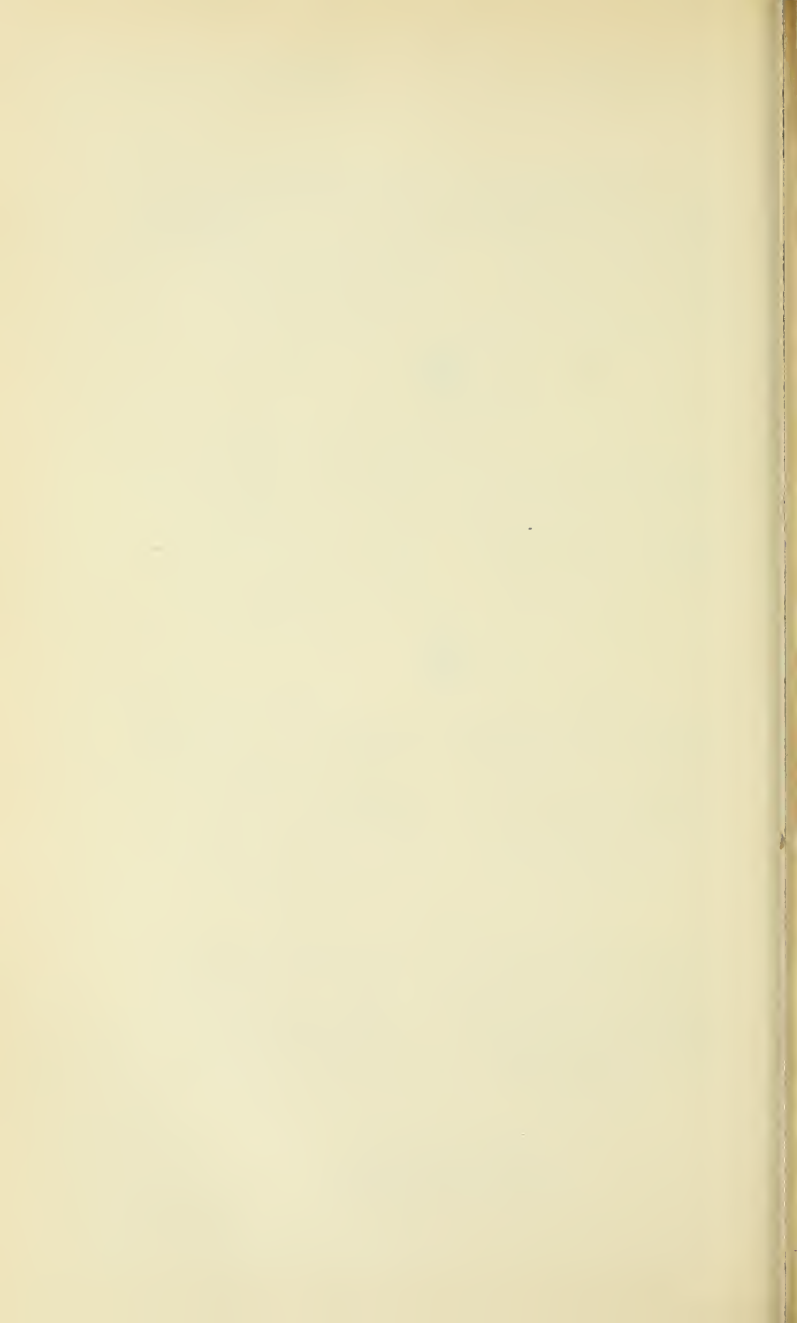
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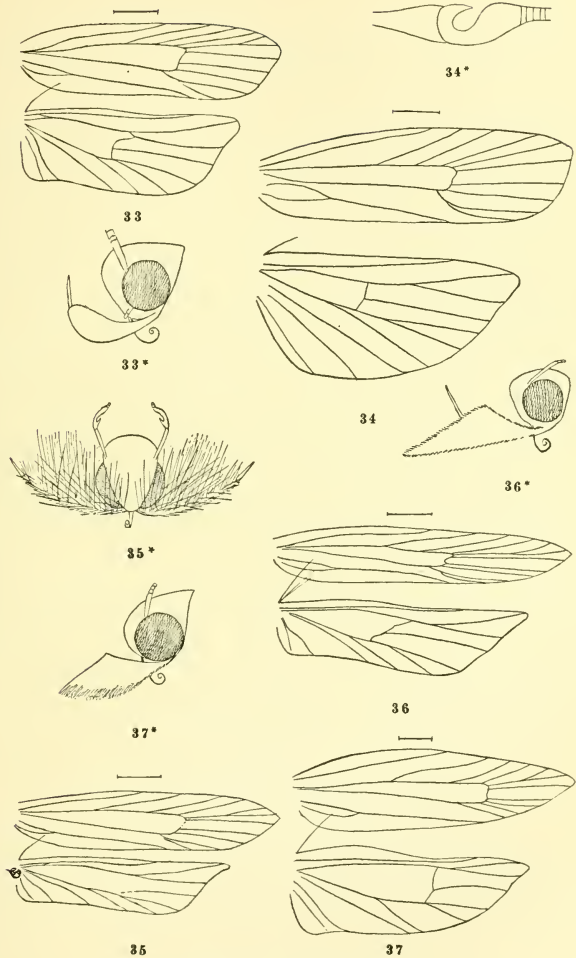




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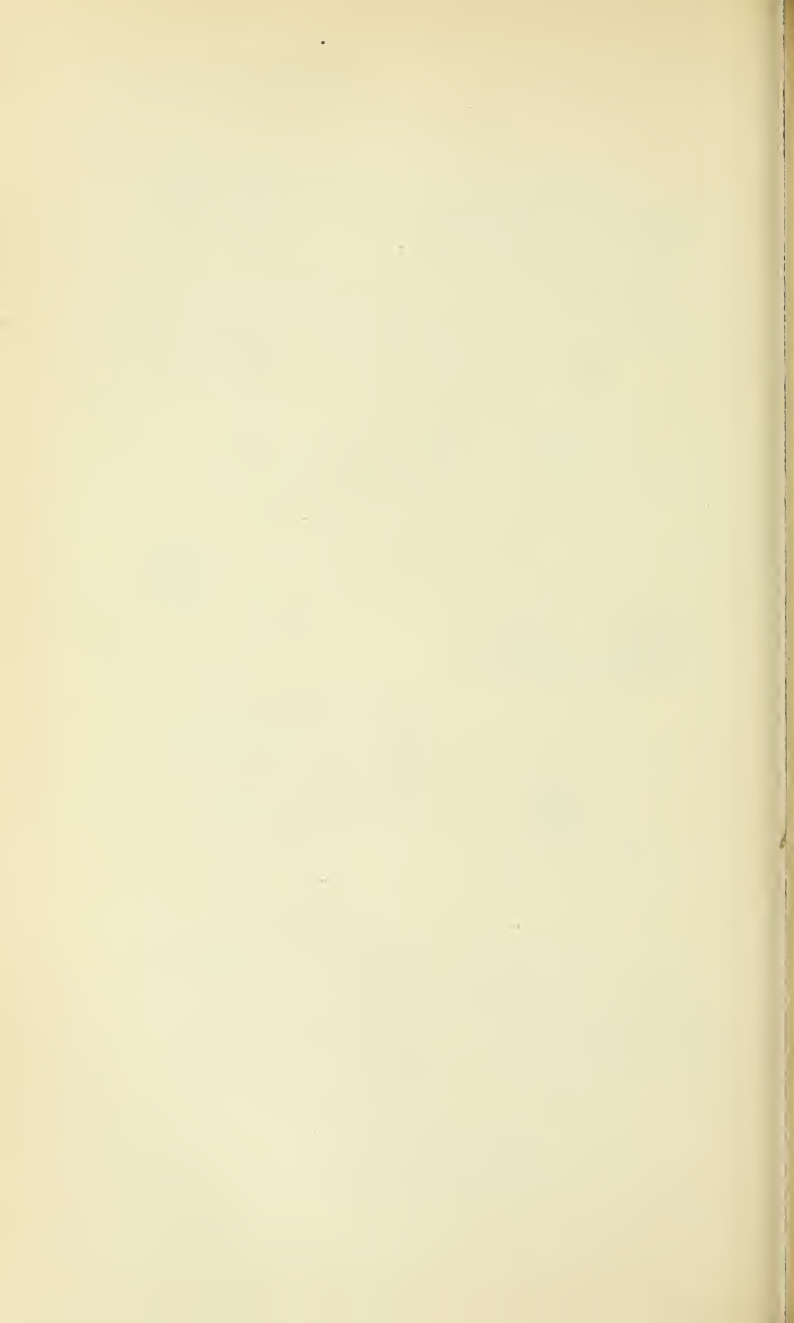
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FOR EXPLANATION OF PLATE SEE PAGE 931.



SUPPLEMENT TO THE REVISION OF AMERICAN GELECHIIDÆ.

It is not surprising in a group of insects like the American *Tineina* that additions and corrections should become necessary soon after the publication of any paper on the subject. The reason for this is that, after many years of quiet in this group of little-known insects, active collecting and study is now being done by several workers. Each month brings much new material and many contributions to our knowledge, which shed light over hitherto obscure facts and permits a fuller comprehension of already described but imperfectly known species. At the same time, large numbers of new forms are discovered.

But these have not been the reasons that have led me to correct my paper before its publication. A very unexpected source of information has come to light in the discovery of the types of the late Brackenridge Clemens, in the Academy of Natural Sciences in Philadelphia. These types had been given up as lost, but were found a short time ago in an old-fashioned box, which had been put away in some out-of-the-way corner and forgotten. My delight in unearthing this gold mine for the student of American *Tineina* quite overshadowed my first very natural chagrin over the changes necessitated in my work.

In another paper I have given particulars of all the other types, but for the purposes of the present paper I shall use only the information gained about the *Gelechiidæ*.

Fortunately, as a whole, the new evidence substantiates my conclusions about Clemens' species. With one exception the only corrections made necessary concern those species, which were left by me as unrecognized, in the genus *Gelechia*.

TELPHUSA LONGIFASCIELLA Clemens.

Telphusa longifasciella BRUCK, Proc. U. S. Nat. Mus., XXV, p. 785.

Clemens' type No. 192 of *Gelechia longifasciella*, which is easily recognized, though lacking the head, proves the synonymy with Chambers' species and the generic position to have been correctly determined.

TELPHUSA FUSCOPUNCTELLA Clemens.

Gelechia fuscopunctella BRUCK, Proc. U. S. Nat. Mus., XXV, p. 895.

The type of *Gelechia fuscopunctella*, Clemens' No. 185, was found in good condition, though, like very many of his types, lacking the wings on the left side.

This type proves the species to belong to the above genus, very close to *Telphusa quercinigracella* Chambers.¹ It is easily mistaken for this species, especially if only flown specimens are at hand. I have, however, good series of both species bred from oak and have blown larvæ of both, and they are undoubtedly distinct. *Quercinigracella* has a darker ground color than *fuscopunctella* and has a distinct oblique dark fascia of raised scales at basal third of the wing, which is absent in *fuscopunctella*. Distinction can only be made with certainty between perfect specimens. When a little flown and rubbed the two species are extremely alike, and are also hard to separate from imperfect specimens of *Telphusa palliderosacella* Chambers. The larvæ of the two species are equally easily mixed up, the more so as they both feed on oak in a similar manner, and both are found together in the District of Columbia.

Careful examination discloses certain constant differences. On the head, which in both species is yellow, *fuscopunctella* has two separate black eye marks on each side, while in *quercinigracella* they are connected and form a longitudinal line; the thoracic shield, which in both species is yellow, is in *fuscopunctella* marked with two central anterior and two larger posterior black spots, while in *quercinigracella* no anterior black marking is found, and the posterior ones are more lateral and more extended, forming a nearly complete black edge. The tubercles are very small, shining, black, and similarly placed in both species, but the hairs in *quercinigracella* are light, whitish, while in *fuscopunctella* they are dark. When mature, the larvæ of both species assume a conspicuous deep reddish coloration, with transverse whitish rings, but the whitish rings are on the middle of the segments in *fuscopunctella*, while in *quercinigracella* it is the intervals between the segments that remain white.

CHRYSOPORA LINGULASELLA Clemens.

Chrysopora lingulasella Busck, Proc. U. S. Nat. Mus., XXV, p. 792.

Clemens' type of *Nomia lingulasella*, No. 81, lacks the wings on the right side, but is easily recognizable and verifies my conception of the species.

ARISTOTELIA ROSEOSUFFUSELLA Clemens.

Aristotelia roseosuffusella Busck, Proc. U. S. Nat. Mus., XXV, p. 796.

Two types in good condition were found of *Gelechia roseosuffusella*, Clemens' No. 70.

These types can not be distinguished from the present conception of the species, but do not thereby remove the uncertainty shown by the writer to exist. Breeding of similar adults from the racemes of *Rhus*, together with careful notes on the larvæ, is still necessary to settle it.

¹ Busck, Proc. U. S. Nat. Mus., XXV, p. 781.

ARISTOTELIA RUBIDELLA Clemens.

Aristotelia rubidella Busck, Proc. U. S. Nat. Mus., XXV, p. 798.

Clemens' type No. 72 of *Gelechia rubidella* is an *Aristotelia*, and confirms the present conception of the species.

ARISTOTELIA FUNGIVORELLA Clemens.

Aristotelia fungivorella Busck, Proc. U. S. Nat. Mus., XXV, p. 798.

Clemens' type Nos. 455-458 of *Gelechia fungivorella* is identical with my bred specimens. I have bred this species again last summer, and believe that the gall-feeding habit recorded by Clemens is merely accidental and that the larva normally feeds in folded leaves of willow.

The species is entirely distinct from the following:

ARISTOTELIA SALICIFUNGIELLA Clemens.

Aristotelia fungivorella Busck, Proc. U. S. Nat. Mus., XXV, p. 798.

One perfect type of *Gelechia salicifungiella*, Clemens' No. 459 was found in Philadelphia.

Before knowing this type I felt warranted in regarding this species as merely a variety of *Aristotelia fungivorella* according to Clemens' own suggestion. On the discovery of the type, however, it is at once evident that this assumption was erroneous. The type agrees well with Clemens' description and clearly represents a distinct species, easily separated from all described American species of the genus *Aristotelia* by its bright rust red ground color.

ARISTOTELIA GILVOLINIELLA Clemens.

Aristotelia gilvoliniella Busck, Proc. U. S. Nat. Mus., XXV, p. 803.

Clemens' type No. 189 of *Gelechia gilvoliniella* is identical with specimens regarded by the writer as this species.

ARISTOTELIA ANGSTIPENNELLA Clemens.

Aristotelia kearfottella Busck, Proc. U. S. Nat. Mus., XXV, p. 803.

Gelechia angustipennella Busck, Proc. U. S. Nat. Mus., XXV, p. 891.

Clemens' type No. 194 of *Gelechia angustipennella* proves this species to be an *Aristotelia* and the species described by me as *kearfottella*.

I do not feel blameworthy that I did not recognize this species from Clemens' description. I compared his description repeatedly with this species and believe that the fault can justly be laid to the unsatisfactory description. The two dark dots near the costa at the base of the wing, mentioned by Clemens, are present, it is true, but are only part of the general dark color laid over the wing and should not be specially men-

tioned more than similar spots near the dorsal edge. The same is the case with the "oblique, short, dark fuscous streak." The special mention of these marks conveys the erroneous idea, that there are not any other similar marks. Moreover, the characteristic yellow costal streak at apical third and the entire apical ornamentation is not mentioned by Clemens, who had a flown specimen before him in which these markings were worn off.

RECURVARIA APICITRIPUNCTELLA Clemens.

Recurvaria apicitripunctella Busck, Proc. U. S. Nat. Mus., XXV, p. 808.

Clemens' type No. 77 of *Eragora apicitripunctella* lacks the wings on the right side, but is otherwise in perfect condition and proves my determination of the species to have been correct. It is the small ochereous species described later by Packard as *Gelechia abietisella*,¹ not as determined by Lord Walsingham, the larger, darker fuscous species described by Zeller as *Gelechia gilvoscopella*.²

TRYPANISMA PRUDENS Clemens.

Trypanisma prudens Busck, Proc. U. S. Nat. Mus., XXV, p. 815.

Clemens' type No. 82 of this species is like my bred specimens, thus confirming the present conception.

EPITHECTIS SUBSIMELLA Clemens.

Epitheatis subsimella Busck, Proc. U. S. Nat. Mus., XXV, p. 819.

The head and thorax are all that there is left of the type of *Parasia* ? *subsimella*, Clemens' No. 98, and they are not in sufficiently good condition to definitely determine the species.

The fragments, however, agree with the corresponding parts of the specimen which I determined as this species, and in the absence of further light this must be accepted as representing the species, which I feel confident it does.

EPITHECTIS GALLÆGENITELLA Clemens.

Epitheatis gallægenitella Busck, Proc. U. S., Nat. Mus., XXV, p. 819.

Clemens' type No. 229 of *Gelechia gallægenitella* is in good condition, though lacking the left wings. It confirms my identification of the species.

GNORIMOSCHEMA BRACKENRIDGIELLA Busck.

Gelechia brackenridgiella Busck, Proc. U. S. Nat. Mus., XXV, p. 894.

The type of *Gelechia detersella*, Clemens' No. 75, was found in good condition, though lacking the left wings.

¹ Rept. Dept. Agr., 1860, p. 150.

² Verh. zool-bot. Gesell., Wien, XXIII, 1873, p. 266.

It proves the species to belong to the genus *Gnorimoschema* Busck, and is very close to but distinct from *scutellariella* Chambers.¹ The differences are not apparent to the naked eye, but under the lens it is easily seen that the ground color in *detersella* is whitish overlaid with dark fuscous, each scale being dark tipped, while in *scutellariella* the ground color is dark, with the scales tipped with bluish white. Moreover, *detersella* has three indistinct dark spots on the wings not found in *scutellariella*—on the middle of the cell, on at the end of the cell, and a third still less conspicuous on the fold; only the first of these is mentioned by Clemens. On the other hand *scutellariella* has very indistinct costal and dorsal whitish streaks at apical third not found in Clemens's species.

The removal of this species to *Gnorimoschema* may make the change of specific name questionable, but for the present I shall retain the new name.

APROÆREMA NIGRATOMELLA Clemens.

Aproærema nigratomella Busck, Proc. U. S. Nat. Mus., XXV, p. 843.

Clemens' type No. 187 of *Gelechia nigratomella* agrees with the present conception of the species, but his type No. 195 of *Gelechia apicilinella* is unfortunately lost, so that the synonymy of these species as determined by Professor Riley can not be sustained nor rejected. It must remain as settled by Professor Riley, though to my mind this synonymy seems doubtful.

ANACAMPSIS RHOIFRUCTELLA Clemens.

Anacamopsis rhoifruetella Busck, Proc. U. S. Nat. Mus., XXV, p. 845.

Clemens' type No. 71 of *Gelechia rhoifruetella* substantiates my determination of this species.

ANACAMPSIS AGRIMONIELLA Clemens.

Anacamopsis agrimoniella Busck, Proc. U. S. Nat. Mus., XXV, p. 850.

Clemens' type No. 68 of *Gelechia agrimoniella* proves the present conception of that species correct.

ANACAMPSIS LEVIPEDELLA Clemens.

Anacamopsis levipedella Busck, Proc. U. S. Nat. Mus., XXV, p. 851.

Clemens' perfect type No. 182 of *Strobisia levipedella* is the same as specimens thus determined by the writer, and definitely proves that the species belongs to the present genus.

GELECHIA MEDIOFUSCELLA Clemens.

Gelechia mediofuscella Busck, Proc. U. S. Nat. Mus., XXV, p. 885.

Clemens' type No. 188 of this species proves Lord Walsingham's identification of this common form to be correct.

¹ Busck, Proc. U. S. Nat. Mus., XXV, p. 834.

GELECHIA GILVOMACULELLA Clemens.

Gelechia gilvamaculella Busck, Proc. U. S. Nat. Mus., XXV, p. 896.

The type of this species, Clemens' No. 290, proves it to be a true *Gelechia* and the same as *Gelechia viminimaculella* Chambers.¹ This name, therefore, must give way to the earlier one of Clemens. Specimens of this species compared with both Clemens' and Chambers' types are now in the U. S. National Museum.

GELECHIA PULLIFIMBRIELLA Clemens.

Gelechia pullifimbriella Busck, Proc. U. S. Nat. Mus., XXV, p. 900.

Clemens' type No. 191 of this species proves it to be a small, nearly unicolorous, dark fuscous *Gelechia*, unlike any other described species known to me. Clemens' description is accurate, but the discal spots he mentions are very indistinct and easily overlooked. Alar expanse, 12 mm.

GELECHIA BRUMELLA Clemens.

Gelechia brumella Busck, Proc. U. S. Nat. Mus., XXV, p. 893.

The type of this species, Clemens' No. 196, shows that the species belongs to *Gelechia*, and that it is nearest *Gelechia vernella* Murtfeldt.² It is, however, a larger species, with alar expanse of 20 mm., and it has a deeper brown ground color.

GELECHIA ORNATIFIMBRIELLA Clemens.

Gelechia ornatifimbriella Busck, Proc. U. S. Nat. Mus., XXV, p. 899.

Clemens' type No. 228 proves the species to be a true *Gelechia* and identical with Zeller's *Gelechia unctulella*,³ which name must be dropped for the earlier *ornatifimbriella*. Clemens' description is very poor, both imperfect and incorrect, and should not be relied on for identification of the species.

GELECHIA VIDUELLA Fabricius.

Gelechia labradoriella Busck, Proc. U. S. Nat. Mus., XXV, p. 897.

Type No. 186 of *Gelechia labradoriella* is in poor condition, but easily recognizable from Clemens' description. I can find no differences between it and authentic specimens of the European *Gelechia viduella* Fabricius, with which it was tentatively made a synonym in Staudinger and Rebels's Catalogue Lepidoptera Europe, No. 2618, 1901, and the species must be known by this much older name.

It is a striking species of the black and white marked group, and comes between *Gelechia lugubrella* Fabricius and *albilorella* Zeller,

¹ Busck, Proc. U. S. Nat. Mus., XXV, p. 881.

² Idem., p. 884.

³ Idem., p. 878.

differing from the former by the white head and the triangular white costal spot between the two fasciæ, and from the latter by its dark thorax and straight outer fasciæ, as well as by the form of the costal spot.

GELECHIA PUNCTIFERELLA Clemens.

Gelechia punctiferella Busck, Proc. U. S. Nat. Mus., XXV, p. 900.

The undoubtedly authentic type of this species, Clemens' No. 193, agreeing minutely with his description, proves that the species does not belong to the family *Gelechiida*, but that it is the same species which Zeller subsequently¹ described as *Hyppatima subsemella*.

The generic determination of this species by Zeller may need correction, but as Lord Walsingham is working on a monograph of the *Blas-tobasida* I shall leave this question to his judgment, and for the present retain the species in *Hyppatima*. Clemens' earlier specific name, however, must replace *subsemella*.

GELECHIA FLEXURELLA Clemens.

Gelechia flexurella Busck, Proc. U. S. Nat. Mus., XXV, p. 895.

Clemens' types of this species No. 94 and 95, according to his list, are unfortunately lost, and the species remains unrecognized; provisionally retained in *Gelechia*.

GELECHIA MIMELLA Clemens.

Gelechia mimella Busck, Proc. U. S. Nat. Mus., XXV, p. 898.

The type of this species, Clemens' No. 96, is also lost, and the species remain in the same condition as the foregoing.

MENESTA TORTRICIFORMELLA Clemens.

Menesta tortriciformella Busck, Proc. U. S. Nat. Mus., XXV, p. 903.

Clemens' type No. 100 of this species proves the present conception correct.

STROBISIA IRRIDIPENNELLA Clemens.

Strobisia irridipennella Busck, Proc. U. S. Nat. Mus., XXV, p. 904.

Type No. 73 of this species verifies the present conception.

STROBISIA EMBLEMELLA Clemens.

Strobisia emblemella Busck, Proc. U. S. Nat. Mus., XXV, p. 905.

Type No. 74 of this species verifies the present conception.

TRICHOTAPHE FLAVOCOSTELLA Clemens.

Trichotaphe flavocostella Busck, Proc. U. S. Nat. Mus., XXV, p. 908.

Clemens' type No. 69 of *Gelechia flavocostella* confirms the present conception of the species.

¹Verh. k. k. zool-bot. Gesell. Wien, XXIII, 1873, p. 302.

TRICHOTAPHE ALACELLA Clemens.

Trichotaphe alacella Busck, Proc. U. S. Nat. Mus., XXV, p. 909.

Clemens' type No. 115 of this species confirms the present conception.

TRICHOTAPHE JUNCIDELLA Clemens.

Trichotaphe juncidella Busck, Proc. U. S. Nat. Mus., XXV, p. 910.

Clemens' type No. 79 verifies the present conception of this species.

TRICHOTAPHE SETOSELLA Clemens.

Trichotaphe setosella Busck, Proc. U. S. Nat. Mus., XXV, p. 911.

Clemens' type No. 78 of this species substantiates my contention against Lord Walsingham's determination and proves that it is rightly placed under *Trichotaphe*.

ANORTHOSIA PUNCTIPENNELLA Clemens.

Anorthosia punctipennella Busck, Proc. U. S. Nat. Mus., XXV, p. 918.

Clemens' type No. 66 of this species confirms the present conception.

YPSOLOPHUS LIGULELLUS Hübner.

Ypsolophus ligulellus Busck, Proc. U. S. Nat. Mus., XXV, p. 921.

Clemens' type No. 206 of *Ypsolophus pauciguttellus* verifies the synonymy with the above species, as determined by Lord Walsingham.

The type of *Ypsolophus flavicittellus* is lost, but there is no doubt of this species being the extreme variety of the same species.

YPSOLOPHUS PUNCTIDISCELLUS Clemens.

Ypsolophus punctidiscellus Busck, Proc. U. S. Nat. Mus., XXV, p. 922.

Clemens' type No. 205 confirms the present conception of this species.

ANARSIA LINEATELLA Zeller.

Anarsia lineatella Busck, Proc. U. S. Nat. Mus., XXV, p. 928.

Clemens' types, male and female, of *Anarsia pruniella*, Nos. 86, 87, confirms the present conception of this species as synonymous with the European *lineatella* Zeller.

A REVIEW OF THE DRAGONETS (CALLIONYMIDÆ) AND RELATED FISHES OF THE WATERS OF JAPAN.

By DAVID STARR JORDAN and HENRY W. FOWLER,

Of the Leland Stanford Junior University.

In this paper is given an account of the *Callionymidæ* of Japan. It is based on specimens collected by Jordan and Snyder in the summer of 1900 and specimens collected by the U. S. Fish Commission steamer *Albatross*. Series are deposited in the United States National Museum and in the museum of Leland Stanford Junior University.

Two families may be recognized among the Japanese Dragonets:

- a. Preopercle unarmed; opercle and subopercle rudimentary, each with a straightish, sharp spine; no lateral line; gill openings moderate DRACONETTIDÆ, I.
- aa. Preopercle with a long spine at its angle; opercle unarmed; lateral line present; gill openings very small.....CALLIONYMIDÆ, II.

Family I. DRACONETTIDÆ.

This family is allied to the *Callionymidæ*, differing very widely in the armature of the head, the preopercle being entire, the opercle and subopercle reduced, each consisting mainly of a nearly straight, sharp, simple spine. The gill openings are much wider than in *Callionymus*, but the gill membranes are broadly united to the isthmus. No lateral line. In spite of the singular armature of the head, this group probably belongs near to the *Callionymidæ*, which family it resembles in external characters. It has also much in common with *Bembrops* and *Pteropsaron*.

1. DRACONETTA Jordan and Fowler.

Draconetta JORDAN and FOWLER, new genus (*xenica*).

The characters of the genus are included above.

(*draconetta*, a quasi-Latin form of the English name Dragonet.)

1. DRACONETTA XENICA Jordan and Fowler, new species.

Head, $3\frac{1}{2}$ in length; depth, 7; D. III-12; A., 12; P., 23; V. I. 5. Body elongate, compressed in front, and with the greatest depth about the anterior dorsal region, the trunk more or less rounded, and tapering behind. Head moderately large, compressed above so that its greatest

depth is two-thirds its width; the upper profile greatly inclined, a blunt angle forming over the eyes; snout pointed, compressed, its length two-thirds its width and also a little more than half the eye; eyes very large, superior, almost touching each other, directed upward, and about $2\frac{2}{3}$ in the head; mouth large, inferior, equal to the eye, and the maxillary extending for the first third of the eye; teeth in the jaws in villiform bands; the upper jaw protrudes but very slightly beyond the lower; edge of preoperculum entire; operculum and suboperculum each with strong spine posteriorly, the lower about in the middle of the height of body and the upper above and directed obliquely upward, with its posterior portion curved; top of the head striate behind the eyes. Gill opening rather broad.

Origin of spinous dorsal over that of the pectorals, the first spine the longest and equal to the space between the origins of the two pectorals, which is greater than the height of the body; soft dorsal much higher than the spinous dorsal, its origin in advance of that of the

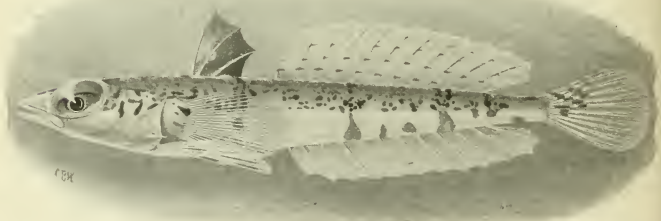


FIG. 1.—*DRACONETTA XENICA*.

anal; anal high, its base a little less than the soft dorsal; pectorals shorter than the head; ventrals jugular, shorter than the pectorals, not reaching the vent, and one-third as long again as the first dorsal spine; caudal fin long, equal to the ventral, and rounded. Caudal peduncle deeper than broad, its depth 2 in the eye.

Color in alcohol very pale brown, a little darker above, and mottled and spotted with dark brown; 5 rather indistinctly defined pairs of double dark-brown bars over the back; head spotted above; spinous dorsal blackish; soft dorsal and anal with several narrow, wavy, longitudinal bands; base of caudal spotted above; pectorals and ventrals plain, the former with a black spot at base; sides of the trunk behind the vent and below, with pale brown blotches; lower surface of the body anteriorly white.

Here described from a specimen $2\frac{9}{16}$ inches long, dredged at Station 3700, in Suruga Bay, at 100 fathoms, by the U. S. Fish Commission steamer *Albatross*.

This species is known to us from a single specimen $2\frac{1}{2}$ inches long, No. 50816, U.S.N.M., dredged at Station 3700, in Suruga Bay, off Namazu, by the U. S. Fish Commission steamer *Albatross*, in 100 fathoms, in company with *Sphagebranchus moseri*.

(Ξενικός, strange.)

Family II. CALLIONYMIDÆ.

DRAGONETS.

Body elongate, naked; head broad and depressed; the mouth narrow, the upper jaw very protractile; teeth very small, in jaws only; preopercle armed with a strong spine, opercle unarmed. Eyes moderate, usually directed upward. Lateral line present, often duplicated. Dorsal fins 2, or sometimes united at base; the anterior with 4 flexible spines; soft dorsal and anal short, the latter without distinct spine; ventrals I, 5, jugular in position, widely separated from each other; pectoral fins large. Gill openings small, the membranes broadly attached to the isthmus; gills 4, a slit behind the fourth; pseudobranchiæ present. No air bladder. Vertebrae usually $8 + 13 = 21$. Sexes notably different in color. The dorsal fin higher in the male. Small fishes of the shores of warm seas, chiefly of the Old World, allied to the *Trachinidæ*, according to Boulenger, but resembling the *Cottidæ* in form.

a. Preopercular spine simple, sharp, spear-like, with serrate edge, but without recurved hooks above or at tip..... *Calliurichthys*, 2.

aa. Preopercular spine not simple, with recurved tip and with one or more recurved hooks above.

b. Ventrals entire, the outer ray not detached; head depressed; gill opening reduced to a very small foramen on upper surface of head; lateral line single.

Callionymus, 3.

2. CALLIURICHTHYS Jordan and Fowler, new genus.

Calliurichthys JORDAN and FOWLER, new genus (*japonicus*).

This genus differs from *Callionymus* in the character of the preopercular spine, which is long, simple, straight or curved, and serrulate, but without recurved hooks above. A small antrorse spine at its base below. In the typical species the caudal fin is greatly elongate. The dorsal spines are graduated backward, at least the first two being elongate.

(κάλλις, beauty; οὐνά, tail; ἰχθύς, fish.)

a. Top of the head covered with rough bone.

b. Body very elongate, the head $3\frac{1}{2}$ in length, the depth 10; top of head with two rough patches; caudal fin very long, especially in males; D. IV-9; A., 8.

japonicus, 2.

bb. Body rather stout, the head about $2\frac{3}{4}$ in length, the depth $7\frac{3}{4}$; top of head with a single rough patch; D. IV-8; A., 7..... *variegatus*, 3.

aa. Top of head covered with smooth skin; head $3\frac{1}{4}$ in length, depth about $8\frac{1}{2}$; D. IV-9; A., 9; dorsal spines much elongated..... *doryssus*, 4.

2. *CALLIURICHTHYS JAPONICUS* (Houttuyn).YOMEGOCHI (BRIDE KOCHI).¹

Callionymus japonicus HOUTTUYN, Verh. Holl. Maatsch. Wet. Harlem, XX, 1782, p. 311; Nagasaki.

Callionymus reevesi RICHARDSON, Voy. Sulphur, Fishes, 1844, p. 60, pl. xxxvi, figs. 1-3; Canton.—RICHARDSON, Ich. China, 1846, p. 210; Hongkong, Macao.—BLEEKER, Verh. Bat. Genoot., XXV, 1853, Nalez. Ich. Japan, p. 44; Nat. Tyds. Ned. Ind., V, 1853, Ceram, III, p. 244; China.

Callionymus longicaudatus SCHLEGEL, Fauna Japonica, Poiss., 1845, p. 151, pl. LXXIX, fig. 1; Nagasaki.—BLEEKER, Act. Soc. Sc. Indo-Neerl., III, 1857, Japan, IV, p. 17; Nagasaki.—GÜNTHER, Cat. Fish., III, 1861, p. 148; China.

Head $3\frac{1}{2}$ in length; depth 10; D. IV-9; A. 8; P. 20; V. I, 5. Body very elongate, much compressed in front, and with the greatest depth about the anterior dorsal region; trunk broader than deep, more or less rounded, and tapering backward. Head compressed above, so that its greatest depth is one-half its breadth; snout pointed, compressed above, the depth two-thirds the length, and a bony ridge forming directly in front of the eyes, but without a distinct bony ridge in

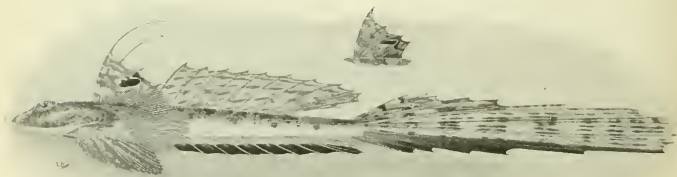


FIG. 2.—*CALLIURICHTHYS JAPONICUS*.

front of each nostril; eyes close together on top of the head, directed upward, $1\frac{1}{2}$ in the snout, 3 in the greatest width, and $4\frac{2}{3}$ in the length of the head; mouth small, inferior, the jaws equal, and the maxillary reaching the nostril; teeth minute, and in bands in the jaws; lower lips a little broad on each side; the preoperculum with a strong, sharp spine directed backward, in some examples a trifle longer than the eye, the upper edge with small sharp antrorse barbs, and the base in front with a short spine directed forward; top of the head with two elevated buckler-like crests, striate, and separated from each other by the smooth integument of the head. Gill openings small, round, on the upper surface of the body a short distance in front of the origin of the dorsal, as far apart as the space between the outer margins of

¹ Kochi (*gochi* in composition) is the vernacular name of all species of *Platycephalus*, and of *Callionymus*.

the eyes, and nearer the posterior margin of the latter than the origin of the pectoral.

Spinous dorsal inserted midway between or nearer the anterior margin of the eye and the origin of the soft dorsal, the spines slender, long, and the first two produced into long, thin filaments till the first is equal to two-fifths the length of the body; the dorsal spines are graduated from the first two, which are the longest; origin of the soft dorsal a little nearer the tip of the snout, and the base of the last anal ray of nearly uniform height, the last ray the longest and produced; anal originating under the second dorsal ray, lower than the soft dorsal, the last ray produced; pectorals between the origin of the spinous dorsal and that of the soft dorsal, broad, and forming an angle with the lower rays the shortest; ventrals large, broad, longer than the pectorals, originating before the gill opening but not reaching the tips of the pectorals, the rays graduated to the inner, which is the longest, and joined to the base of the pectoral in front by a broad membrane; caudal very long, strong, graduated above and below to the middle rays which are the longest, and equal to the body without snout. Caudal peduncle long, compressed, and the depth less than the eye.

Color of male in spirits, deep rich brown above, with numerous rounded spots and blotches of pale brown margined more or less with dark brown, and about six pale, rather broad cross bands; on the sides of the trunk are six dark brown blotches; lower surface of the body pure white, except a deep rich brown blotch on the chest; branchiostegals grayish-brown; spinous dorsal dark gray with a number of pale-gray blotches, and on the upper part posteriorly a larger jet black ocellus; soft dorsal grayish, with narrow bands of longitudinal brown blotches; anal with a broad black band along its lower margin; pectorals with pale spots above; ventrals gray-black with a few darker blotches, and the tips of the rays white; caudal edged with blackish broadly, deep below, and with about seven broad blackish cross bars. The female differs in having the dorsal spines short and not produced into filaments, and with the lower surface pure white without the deep brown blotch on the chest. This description from Wakanoura examples, the largest $11\frac{1}{4}$ inches long.

This species, remarkable for the great length of the caudal fin, is generally common in the bays of southern Japan. Our numerous specimens are from Nagasaki and Wakanoura. They agree with Richardson's plate of *Callionymus reevesi*, and the alleged distinction between Japanese and Chinese specimens mentioned by Bleeker seems to be without value.

3. *CALLIURICHTHYS VARIEGATUS* (Schlegel).

Callionymus variegatus SCHLEGEL, Fauna Japonica, Poiss., 1845, p. 153; Nagasaki.

Head $2\frac{2}{3}$ to $2\frac{7}{8}$ in length; depth $7\frac{1}{2}$ to $8\frac{1}{2}$; D. IV-8; A. 7; P. 17; V. I, 5. Body moderately elongate, much compressed, especially forward, and with the greatest depth about the anterior dorsal region; trunk broader than deep and tapering backward. Head compressed above so that its depth is $2\frac{1}{3}$ in its breadth; snout long, blunt, compressed, its width at the corners of the mouth a little more than the eye, its depth three-fifths its length, its greatest width equal to its length, and $2\frac{2}{3}$ in the head; a bony ridge in front of each eye, eyes close together, on top of the head, directed upward, $1\frac{1}{2}$ to 2 in the snout 3 to $3\frac{1}{2}$ in the greatest width, and $4\frac{1}{2}$ to 5 in the length of the head; mouth small, inferior, the upper jaw protruding and the maxillary reaching three-fourths to three-fifths in the space between the tip of the snout and the anterior margin of the eye; teeth in villiform bands in the jaws; lips rather thin,



FIG. 3.—*CALLIURICHTHYS VARIEGATUS*.

the lower broad on each side; preoperculum with a short sharp spine directed backward, always shorter than the eye, the upper edge with small, sharp antrorse barbs, and the base in front with a short, sharp spine directed forward; top of the head behind the eyes forming a broad, rugosely striate patch. Gill openings small, round, on the upper surface of the body a short distance in front of the origin of the dorsal, as far apart as the space between the outer margins of the eyes, and a trifle nearer the origin of the pectoral than the posterior margin of the eye.

Origin of the spinous dorsal midway between or a little nearer the posterior margin of the eye than the origin of the soft dorsal; spines long, slender, and the first two produced into long filaments till they are equal to three-sevenths the length of the body; the dorsal spines are graduated from the first two, which are the longest; origin of the soft dorsal nearer the base of the caudal than the tip of the snout, the fin high, uniform, and the last ray the longest and produced; origin of the anal

between the second and third dorsal rays, lower than the soft dorsal, the last ray very long, produced, and reaching farther posteriorly than the tip of the last dorsal ray; origin of pectorals nearer the origin of the spinous dorsal than the origin of the soft dorsal by nearly three-fourths the distance between, broad, and forming an angle with the lower rays the shortest; ventrals broad, larger, longer, than the pectorals, the rays graduated to the inner which is the longest; caudal very long, strong, graduated above and below to the middle rays which are the longest and nearly equal to $1\frac{1}{2}$ in the body. Caudal peduncle long, broad, compressed, and the depth a little less than the eye. Lateral line with minute pores.

Color of male in alcohol dark brown above, with numerous rounded blotches and spots of pale brown margined more or less with deeper, and about six pale rather broad cross bars; a narrow dark brown bar across the snout above, several from the eye, and one across the operculum to the sides of the head; sides of the head, and trunk, with short narrow irregular pale bluish bars and spots edged with whitish, on the former often in pairs, the space between and on each side dark brown; the brown blotches of the flanks with one or two small jet black ocelli; lower surface of the body whitish, with a deep brown blotch on the under surface of the head between the branchiostegals; spinous dorsal grayish with blackish brown blotches and lines, a deep black blotch and several white lines posteriorly; soft dorsal pale, with alternate wavy lines of gray and black; anal grayish black, and the outer part of the last ray black; pectorals pale with small dark spots above; ventrals gray, space behind the first three rays deep black and the rest of the fin more or less speckled with blackish brown; caudal with six or seven blackish bars, and with many fine wavy bars, lower rays pale and plain. The female differs in having the dorsal spines without filaments, the caudal and body shorter, the color plainer without the black lateral ocelli, the anal fin whitish with a narrow black marginal band, and without a brown blotch on the underside of the head. Description from Nagasaki specimens, the largest male $6\frac{5}{8}$ inches.

This species is moderately common in the bay of Nagasaki, where our specimens were taken. Dr. Günther erroneously regards this species as the female of *Calliurichthys japonicus*.

(*variegatus*, variegated).

4. CALLIURICHTHYS DORYSSUS Jordan and Fowler, new species.

Head 3 to $3\frac{1}{2}$ in length; depth $7\frac{1}{2}$ to $10\frac{3}{4}$; D. IV-9; A. 9; P. 20; V. I, 5. Body elongate, compressed above and with the greatest depth about the anterior dorsal region; trunk broader than deep and tapering backward. Head compressed above so that its depth is $2\frac{1}{3}$ in its breadth; snout moderate, bluntly pointed, compressed, its depth $1\frac{2}{3}$

in its length, which is 3 in the head; bony ridge in front of the eye not conspicuous; eyes close together, on top of the head, directed upward, 1 to $1\frac{1}{2}$ in the snout, $2\frac{1}{3}$ to $3\frac{1}{3}$ in the width and $\frac{1}{2}$ to $\frac{1}{2}$ in the length of the head; mouth small, inferior, the upper jaw protruding, and the maxillary not reaching to the nostril; teeth in villiform bands in the jaws; lips rather thin, the lower broad on each side; preoperculum with a sharp spine directed backward equal to the eye, the upper edge with small, sharp, antrorse barbs and the base in front with a short, sharp spine directed forward; head entirely smooth above and without any asperities. Gill openings small, round, on the upper surface of the body a short distance in front of the origin of the dorsal, as far apart as the outer margins of the eyes, and much nearer the eye than the base of the pectoral.

Origin of spinous dorsal midway, or a little nearer to the posterior margin of the eye than the origin of the soft dorsal; spines long,

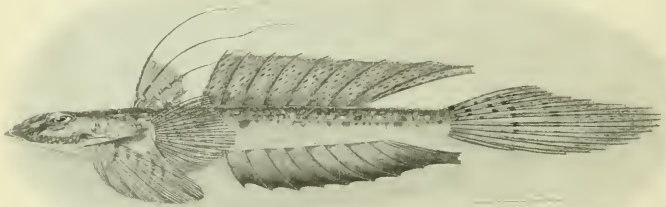


FIG. 4.—CALLIURICHTHYS DORYSSUS.

slender, produced into long filaments, the first the longest, graduated to the last, which is the shortest, and contained in the body about $1\frac{1}{2}$ times; origin of soft dorsal nearer the base of the last anal ray than the tip of the snout, the fin rising behind to the last ray, which is the longest; origin of the anal a little behind the second dorsal ray, the fin growing deeper behind to the last ray, which is the longest, and its tip reaching about as far as that of the last dorsal ray; origin of pectorals nearer the origin of the spinous dorsal than that of the soft dorsal; the middle rays produced into a point and the lower the longest; ventrals shorter than the head, longer than the pectorals, the inner rays the longest, and joined to the base of the pectorals in front by a membrane; caudal moderately long, the middle rays the longest and strongest. Caudal peduncle compressed, broader than the depth, which is less than the eye.

Color in alcohol brown above, with numerous rounded blotches and spots of pale brown margined more or less with deep brown, and

about six rather broad, pale, cross bars; on the sides of the trunk are about six dark brown blotches, lower surface of the body white; spinous dorsal gray with dark spots, the filaments barred even to near their tips, and several white ocelli on the lower part of the fin; soft dorsal pale, with numerous blackish specks; anal blackish, deeper toward the tips of the rays, and the base marked with few very pale blotches; pectorals with pale spots above; ventrals blackish gray with a few dark specks, and the tips of the rays white; caudal edged with blackish, and with six blackish cross bars made up of small spots. Color of the male and female not different, the latter with the spinous dorsal filaments, but the young without them, and the anal plain white, except a narrow blackish band on the lower half. Here described from specimens from Nagasaki, the largest $7\frac{1}{4}$ inches long.

Our many specimens are from Nagasaki, Wakanoura, and Aomori. The type is No. 7186, Leland Stanford Junior University Museum, Cotypte, is in the U. S. National Museum. This species differs from the others of the genus in the smooth head and highly elevated dorsal spines.

(*δορῦσσοσ*, spear-bearer.)

3. CALLIONYMUS Linnæus.

Callionymus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 249 (*Igra*).

This genus includes Dragonets with the ventral fins entire, without detached ray, the gill opening reduced to a small foramen, opening upward, and the lateral line single; head triangular, depressed; eyes directed upward; preopercular spine very large, hooked at tip and with one or more recurved spines above; a small autorse spine at its base below; opercle unarmed; sexual differences strongly marked. Species numerous, living on the bottoms in warm seas. In America the few species live at a considerable depth. In the Mediterranean, in India, and in Japan they are shore fishes, swarming in all bays and living in shallow water. In Japan they are especially abundant, forming a conspicuous part of the fish fauna.

(*κάλλις*, beauty; *ὄνομα*, name, an old appellation of some sea fish.)

a. Preopercular spine with but two recurved hooks at its tip.

b. Soft dorsal fin very high, its rays branched; a lunate black spot on membrane of last spine; D., IV-8; A., 7; dorsal spines graduated, the first elongate.

altivelis, 5.

bb. Soft dorsal fin moderate, the rays not branched; first dorsal spine only much produced in the male; spinous dorsal in male with a black ocellus; female with the posterior half of the fin black; head rather broad, its width 3 in length.....*lanatus*, 6.

aa. Preopercular spine with three or four recurved hooks above; soft dorsal moderate, its rays not branched.

c. Dorsal fins not joined by membrane.

d. First dorsal fan-shaped, the first and fourth spines being always longest.

- e. First and last dorsal spines very slightly produced, even in males, so that the upper margin of the fin is merely lunate; male with a lunate black blotch on upper edge of spinous dorsal, female with a black ocellus; coloration nearly plain olive; no oblique black streaks on anal.
valenciennesi, 7.
- ee. First and last spines greatly elevated in the males, the second spine shortest; male with spinous dorsal blackish-brown with white reticulated lines; female with the first spine only much produced and with a large black ocellus on dorsal posteriorly; head rather narrow.
flagris, 8.
- dd. First dorsal with the first and second spines about equal, connected by membrane almost to their tips, the third longer, ending in a filament, the fourth shortest and also filamentous; spinous dorsal in males with several black ocelli, females unknown.....*calliste*, 9.
- ddd. First dorsal with the first spine longest.
- f. Spinous dorsal (in female?), uniformly colored; D., IV-10; A., 10.
huguenii, 10.
- ff. Spinous dorsal with white spots and lines, its posterior edge blackish; dorsal spines graduated, the first longest, the others regularly shortened; interorbital space broad; the eyes well separated; anal fin with dark wavy cross bars, very sharply defined in the male.
beniteguri, 11.
- cc. Dorsal fins connected by membrane; second and fourth spines greatly elongate, reaching caudal; spinous dorsal in male mottled and striated.
virgis, 12.

5. CALLIONYMUS ALTIVELIS Schlegel.

BENITEGURI (RED NET-CATCH OR DRAGONET).

Callionymus altivelis SCHLEGEL, Fauna Japonica, Poiss., 1845, p. 155, pl. LXXIX, fig. 1; Bay of Omura (about 15 miles north of Nagasaki).

Head about $2\frac{2}{3}$ (in fig.) in length; depth about $6\frac{1}{2}$ (in fig.); D. IV-8; A. 7; P. 19; V. I, 5. Snout a little convex; the upper border of eyes elevated, and the interorbital space very narrow and concave; preopercular spine with a single large hook above; gill opening round, and lateral; first dorsal opposite the gill opening, the first spine equal to the caudal, the last one-third the length of the first and without a membrane uniting it with the back; height of the second dorsal nearly equal to the head, and all its rays branched; anal beginning below the first third of the soft dorsal, much lower than the same, and, with the exception of the last, all the rays are simple or unbranched; pectorals rounded.

In life brick red; the back marbled with pale brown, below whitish; spinous dorsal marbled with yellow, reddish-brown and greenish, the last color forming a large spot above posteriorly; soft dorsal yellow, with 6 or 7 oblique rose-colored bars; anal pale red, becoming deep behind; membranes of pectorals, ventrals and caudal blue, the rays pale red, the latter with 5 or 6 large, transverse, yellow bars, and the lower margin tinted with red. Length, 8 inches. Bay of Omura. (Schlegel.)

This strongly marked species is known only from Schlegel's account, no specimens having been taken by later writers. Its red coloration, the reduction of the number of hooks on the preopercular spine, and the great height of the soft dorsal should distinguish it.

Omura, the type locality, is about 15 miles north of Nagasaki. (*altus*, high; *velum*, sail.)

6. CALLIONYMUS LUNATUS Schlegel.

Callionymus lunatus SCHLEGEL, Fauna Japonica, Poiss., 1845, p. 155, pl. LXXVIII, fig. 4; Nagasaki (male).—GÜNTHER, Cat. Fish. Brit. Mus., III, 1861, p. 146 (copied).

Callionymus inframundus GILL, Proc. Ac. Nat. Sci. Phila., 1859, p. 129; Japan (female; greenish, marbled with white, first dorsal blackish).

Head $3\frac{1}{4}$ in length; depth, 10; D. IV-9; A. 9; P. 19; V. I, 5.

Body elongate and compressed above; trunk broader than deep and tapering backwards. Head compressed so that its depth is $2\frac{1}{3}$ its width; snout rather pointed, compressed, its length equal to the eye,



FIG. 5.—CALLIONYMUS LUNATUS.

and about $\frac{3}{4}$ its own width; eyes close together, on top of the head, directed upward, $3\frac{2}{3}$ in the length and $2\frac{2}{3}$ in the width of the head; mouth small, inferior, the upper jaw protruding, and the maxillary not reaching the eye; teeth in villiform bands in the jaws; lower lip rather thick, and broad on each side; preopercular spine with two large teeth turned upward, and a short spine projecting from its base forward, embedded in the skin; head smooth. Gill openings round, nearer the origin of the dorsal than the posterior margin of the eyes, and nearer the latter than the origin of the pectoral.

Origin of the spinous dorsal midway or a little nearer the posterior margin of the eyes than the origin of the soft dorsal; the dorsal spines slender, the first produced into a long filament so that its entire length is a little more than the entire space between its own origin and the tip of the snout, or a little less than that between the former and the base of the caudal; the others are about equal; soft dorsal high, its origin nearer the tip of the snout than the base of the caudal, and the last ray

the longest; anal lower than soft dorsal, its origin between the second and the third dorsal rays, and its last ray produced; pectorals with an angle behind, the middle rays the longest, and the lower the shortest; ventrals a little longer than the pectorals, and their outer rays the shortest; caudal about equal to the head, upper rays little shorter than the middle, while the lower are graduated; caudal peduncle greatly compressed, its depth about $\frac{2}{3}$ the eye.

Color of male in alcohol brown above, beautifully mottled, and with minute spots, some forming rings and blotches with light centers, and traces of several broad crossbars; sides of the trunk with five or six dark brown blotches; lower surface of the body white; spinous dorsal gray; a jet black ocellus behind the last spine, and in front each spine marked with darker and white; soft dorsal with three narrow brown bands; anal with a median blackish band, and its edge white; pectorals with a few pale spots above; ventrals grayish, the edges and the tips of the rays whitish; caudal with about four or five crossbars made up of small spots, its edge below white, above which is a broad black band. The female is much like the male but has the spinous dorsal low, the first ray not longer than the others, and with much black posteriorly; the anal fin pale; never an ocellus.

Our description above is from examples from Nagasaki and Wakanoura, the largest about $5\frac{1}{8}$ inches in length. We have specimens from Tsuruga, Wakanoura, Nagasaki, Same, and Niigata. It is evidently generally distributed along the coast.

The male is well distinguished by the high spines and the black spot on the posterior membrane. The female resembles the young of *C. valenciennesi*, but the black spot on the dorsal occupies nearly half the fin.

(*lunatus*, crescent shaped.)

7. CALLIONYMUS VALENCIENNESI Schlegel.

NEZUMEGOCHI (RAT KOCHI); NEZUPO (RAT TAIL).

Callionymus japonicus CUVIER and VALENCIENNES, Hist. Nat. Poiss., XII, p. 299; Japan, coll. Langsdorf (not of Houttuyn).

Callionymus recessi RICHARDSON, Voy. Sulphur, Fishes, 1844, p. 60, pl. xxxvi (female; on a drawing made in Canton not type).

Callionymus valenciennesi SCHLEGEL, Fauna Japonica, Poiss., 1845, p. 153, pl. LXXVIII, fig. 3; Nagasaki (figure very poor).

Callionymus punctatus RICHARDSON, Ichth. China, 1846, p. 210 (after *C. japonicus* Cuvier and Valenciennes).

Callionymus richardsoni BLEEKER, Nat. Tyds. Ned. Ind., VI, 1854, Japan, p. 414; Nagasaki.—BLEEKER, Verh. Bat. Gen., XXVI, 1857, Japan, III; Nagasaki.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 370; Tokyo.

Callionymus curricornis GÜNTHER, Cat. Fish., III, 1861, p. 145; China.—ISHIKAWA, Prel. Cat., 1897, p. 37; Tokyo, Boshu.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 370; Yokohama (not of Cuvier and Valenciennes, from Bourbon Island).

Head $3\frac{1}{3}$ in length; depth 11; D. IV-9; A. 9; P. 20; V. I, 5. Body elongate and compressed above; trunk broader than deep, and tapering backward. Head compressed, its width two-thirds its length, and its depth $2\frac{1}{5}$ in its width; snout rather long, blunt, compressed, much greater than the eye, and its depth two-thirds its length; eyes close together, on top of the head, directed upward, $1\frac{1}{2}$ in snout, $4\frac{1}{2}$ in the head, and $3\frac{1}{2}$ in its width; mouth small, inferior, the jaws nearly equal, and the maxillary not reaching the eye; teeth in villiform bands in the jaws; lower lip thick, and broad on each side; preopercular spine with 4 large teeth turned upward, and a short spine projecting from its base forward, embedded in the skin; head smooth. Gill openings round, nearer the origin of the dorsal than the posterior margin of the eyes, and nearer the latter than the origin of the pectoral.

Spinous dorsal midway between the origin of the soft dorsal and

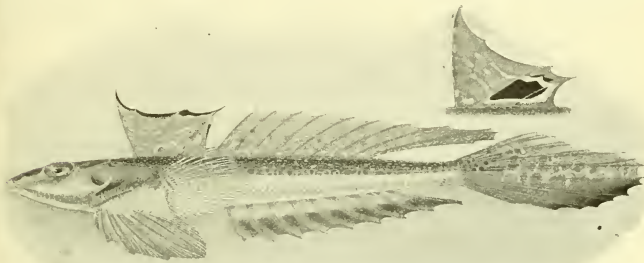


FIG. 6.—CALLIONYMUS VALENCIENNESI.

the middle of the eye; dorsal spines slender and the first and last the longest, about equal, and about a third again as long as the two median ones, so that the edge of the fin is deeply emarginate; soft dorsal high, the first ray somewhat higher than the others, excepting the last, which is very long and produced; anal rather low, lower than the soft dorsal, but its last ray produced till it is equal to two-thirds the length of the last dorsal ray; pectorals with the middle rays the longest, and produced into an angle behind; ventrals a little longer than pectorals; caudal with the middle rays the longest, graduated above and below. Caudal peduncle compressed, and about equal to the eye.

Color of male in alcohol brown above, mottled with minute spots forming rings and blotches with light centers, and traces of several broad crossbars; narrow pale bluish lines on the sides of the head; sides of the trunk with 5 dark-brown blotches, and numerous light-brown narrow lines inclined forward; lower surface of the body white, silvery

on the lower part of the sides; spinous dorsal gray, with white lines, and blotches, the upper margin generally with a narrow black crescent; soft dorsal gray, spotted with white, and also with a few dark brown spots; anal blackish, deep at the margin, and near which is a narrow longitudinal blackish line; pectorals with small pale spots above; ventrals grayish; caudal gray, with dark spots rather large in the center, and its lower rays blackish. The female differs from the male in color, as the black crescent of the spinous dorsal is replaced by a large black ocellus below, and posteriorly the lower rays of the caudal are white; the narrow oblique lines of the sides are absent, and the anal fin is pale or white.

This description from a large series of specimens from Nagasaki, the largest $8\frac{1}{2}$ inches, though we have a large specimen, $10\frac{1}{2}$ inches, from Tokyo.

This species is subject to some variation in color, and the third and fourth dorsal spines are sometimes equal, especially in females, but it may be easily recognized by the lunate margin of the spinous dorsal.

This species is by far the most abundant of the genus in Japan, being found everywhere in sandy bays to the southward of Hakodate and brought in daily to all markets. Our specimens are from Hakodate, Matsushima, Misaki, Yokohama, Tokyo, Enoshima, Tsuruga, Wakanoura, Onomichi, Kobe, Kawatana, and Nagasaki. The sexes differ considerably, but the fan shape of the spinous dorsal fin, its first and last spines being longest, with its peculiar coloration, are always diagnostic.

The species is certainly very close to *Callionymus curvicornis* from the Isle of Bourbon, but the two should not be united without comparison of specimens.

(Named for Achille Valenciennes.)

8. CALLIONYMUS FLAGRIS Jordan and Fowler, new species.

Callionymus japonicus JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 370; Yokohama (not of Houttuyn).

Head $3\frac{1}{2}$ in length; depth $10\frac{1}{2}$; D. IV-9; A. 9; P. 19; V., I, 5. Body elongate, compressed above, the trunk broader than deep and tapering backward. Head compressed, rather narrow, its width two-thirds its length, and its depth 2 in its width; snout rather long, pointed, compressed, much greater than the eye, and its depth a little less than its length; eyes close together, on top of the head, directed upward, a little over 1 in the snout, about $4\frac{1}{2}$ in the head's and $2\frac{3}{8}$ in its width; mouth small, inferior, the lower jaw projecting a little, and the maxillary reaching a little beyond the nostril; teeth in villiform bands in the jaws; lower lip thick, and broad on each side; preopercular spine with 2 or 3 sharp teeth turned upward, and a sharp spine projecting forward from its base embedded in the skin; head smooth. Gill

opening rounded, nearer the origin of the dorsal than the posterior margin of the eyes, and nearer the latter than the origin of the pectoral.

Spinous dorsal midway between the origin of the soft dorsal and the middle of the eye or its posterior margin; dorsal spines all very long and slender, all produced into long, slender filaments, the first very long, sometimes reaching the base of the caudal, the second the shortest, the third longer and closely joined to the last above, which is still longer; dorsal rather high, and the last ray greatly elongated, so that it is nearly equal to the base of the fin; anal beginning a little before the third dorsal, and its last ray about equal to two-thirds the length of the last dorsal ray; pectoral with its median rays the longest, and the angle somewhat rounded; ventrals very long, and extending nearly to the tips of the pectorals; caudal long, about one-half the length of the body, and its middle rays produced into slender filaments. Caudal peduncle compressed, its breadth greater than its depth, which is two-thirds the eye.

Color of males in alcohol, rich brown above, mottled with minute

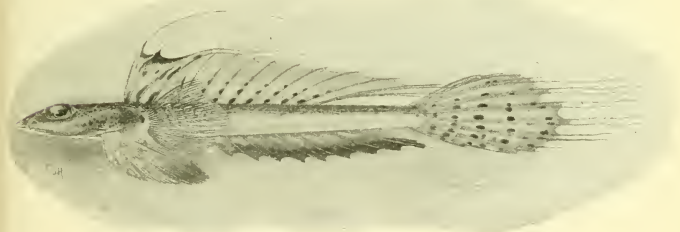


FIG. 7.—*CALLIONYMUS FLAGRIS*.

spots forming rings or blotches with pale centers and traces of several broad crossbars; several pale bluish bars on the sides of the head; sides of the trunk with 5 dark brown blotches: lower surface of the body white; spinous dorsal white, with a number of large black spots, and generally a blackish marginal crescent above; soft dorsal gray, the basal portion with reticulating white lines inclosing large blackish-brown spots; below and above are small pale spots; anal fin gray, becoming blackish toward its margin; pectorals with small spots above, ventrals gray, the outer portion of the rays blackish, and the margin of the fin gray; caudal gray, the middle and lower half with 5 bars of broad gray-black spots. The female differs from the male chiefly in having the dorsal spine short, the first a little longer than the others, and without filaments; the last dorsal ray is short, and the caudal lacks the filaments. The color is more somber, and the anal and the margin of the ventrals are pale. Here described from specimens from Tsuruga and Tokyo, the largest reaching $7\frac{1}{2}$ inches.

Type No. 7187, Leland Stanford, Junior University Museum; cotypes are in the U. S. National Museum.

We have many examples from Aomori, Tsuruga, Kobe, and Nagasaki; also a series from Tokyo from Prof. Otaki and the U. S. Fish Commission steamer *Albatross* dredgings at Station 3722 in Owari Bay and Station 3777 in Matsushima, Bay of Kinkwasan. We have also a small specimen from Tsuruga Bay. It seems to inhabit rather deeper waters than *Callionymus valenciennesi*.

(*flagris*, under the lash.)

9. CALLIONYMUS CALLISTE Jordan and Fowler, new species.

Head $3\frac{1}{4}$ in length; depth $7\frac{1}{2}$; D. IV-8; A. 7; P. 17; V. I, 5. Body elongate, compressed above, the trunk broader than deep and tapering backward. Head compressed so that its depth is two-thirds its width;

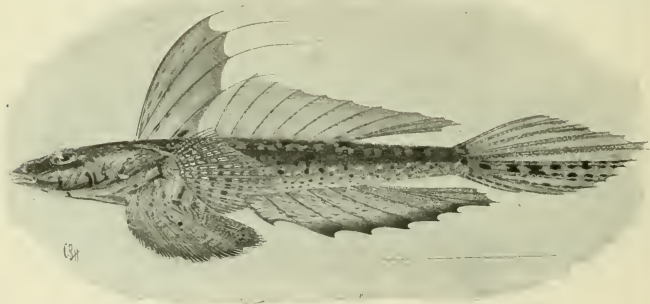


FIG. 8.—CALLIONYMUS CALLISTE.

snout rather pointed and compressed; eyes close together on top of the head, about $1\frac{1}{4}$ in the snout, 4 in the length, and 3 in the width of the head; mouth small, the jaws about equal and the maxillary not reaching the eye; teeth in villiform bands in the jaws; lips rather thin; peropercular spine with three teeth, and a short spine at the base in front, directed forward; head smooth above. Gill opening round, a little farther apart than the distance between the outer margins of the eyes, and about midway between the posterior margin of the latter and the origin of the pectoral.

Origin of the spinous dorsal about halfway between the first third of the eye and the origin of the soft dorsal; dorsal spines long, slender, rather firm, the first and second about equal, a little longer than the base of the soft dorsal, the third longer than either, and its extremity filamentous, the last the shortest, and its extremity also filamentous; the last the shortest, and its extremity also filamentous; the

membrane of the spinous dorsal extends almost to the extremities of the first and second spines; soft dorsal of about uniform height, with the last ray the longest; origin of the anal behind the second dorsal ray, the fin high posteriorly, the last ray produced till much longer than the last dorsal ray, and extending beyond it; pectoral broad, three-fourths the length of the first dorsal spine; ventral shorter than the first dorsal spine; caudal with the middle rays the longest, and graduated above and below, so that the fin is pointed and $2\frac{1}{2}$ in the body; caudal peduncle compressed, and about equal to the eye.

Color in alcohol, dark brown above, with many dark reticulations, mottlings, and 5 narrow dark-brown crossbars; below white, along the base of the anal spotted with brown, and the sides with blackish; several dark bars and light-brown lines on the sides of the head; spinous dorsal gray, with several black ocelli at the base, and marked with darker gray lines and spots; soft dorsal gray, the rays spotted with dark gray brown; anal grayish white, its margin blackish, and the fin mottled behind with grayish; pectoral rays spotted with brownish; ventrals gray, with a broad grayish-black band near the margin, which is narrowly whitish, the fin with narrow whitish cross lines, and the inner rays more or less speckled with grayish; caudal gray, the middle rays with rather large blackish spots, and above and below with small whitish spots. This description from 3 males taken at Misaki, the longest $3\frac{1}{2}$ inches.

Type No. 7188, Leland Stanford Junior University Museum; cotype is in the U. S. National Museum.

Of this species, the most strikingly colored of the group, we have several specimens from the rock pools of Misaki.

(*καλλίστη*, very beautiful.)

10. CALLIONYMUS HUGUENII Bleeker.

Callionymus huguenii BLEEKER, Act. Soc. Sc. Indo. Neerl., V, 1858, Japan, V, p. 7, pl. II, fig. 1; Nagasaki.—GÜNTHER, Cat. Fish, III, 1861, p. 145 (copied).

Head $3\frac{1}{2}$ in length; depth $7\frac{1}{2}$; D. IV-10; A. 10; P. 17; V. I, 5. Body elongate, depressed, and its greatest breadth about $4\frac{1}{2}$ in its length. Head with its breadth $1\frac{1}{3}$ and its depth $2\frac{1}{3}$ to $2\frac{1}{4}$ in its length; eyes close together, 3 in the head; snout less than its width at base; preopercular spine with 3 teeth. Gill opening superior. Origin of the spinous dorsal behind the gill opening, the spines slender, filamentous, the first the longest, and much longer than the head; soft dorsal highest posteriorly; anal highest posteriorly and the last ray the longest; pectoral about 5 in the body; ventral about $5\frac{1}{2}$ in the body; caudal strongly pointed, $3\frac{1}{3}$ to $3\frac{1}{4}$ in the total length.

Body above rosy-green, below whitish; head, back, and sides above variagated with deep olive blotches and pearly ocelli; sides of the head with pale-blue ocelli, the rings violet; fins pale rosy-green, the

spinous dorsal plain; the soft dorsal with numerous small brown spots; margin of anal blackish brown; the pectoral plain; the ventrals with violaceous diffused on the outer portion of the inner rays, and the caudal with 5 or 6 series of transverse spots.

Length 7.9" (about 3¼ inches); Nagasaki (Bleeker).

This species is known to us from Bleeker's description only.

11. *CALLIONYMUS BENITEGURI* Jordan and Snyder.

Callionymus beniteguri JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 376, pl. xvii; Tokyo Bay.

Head 3 in length; depth 10; D. IV-9; A. 9; P. 19; V. I, 5. Body elongate, compressed above, the trunk broader than deep, and tapering backward. Head compressed so that its depth is 2½ in its width; snout broad, compressed, and its depth greater than the eye; the inter-orbital space is broader than that of any other species of this genus; the eyes well separated, about 5 in the length and 4½ in the width of the head; mouth small, inferior, the upper jaw projecting, and the maxillary reaching as far posteriorly as the nostril; teeth in villiform bands in the jaws; lower lip rather thick, and broad on each side; preopercular spine with about 3 large teeth turned upward and a short spine projecting from its base forward, embedded in the skin; head smooth. Gill openings round, nearer the origin of the dorsal than the posterior margin of the eyes, and midway, or nearer the latter than the origin of the pectoral.

Origin of spinous dorsal a little nearer, or midway between, the posterior margin of the eyes than the origin of the soft dorsal; the spines rather short, slender, the first two ending in filaments of about equal length, and about as long as the height of the fin; sometimes soft dorsal of uniform height, and the last ray the longest and produced till it is much longer than the last anal ray; origin of the anal a little in front of the third dorsal ray; pectorals very broad, and with a blunt angle behind; ventrals large, nearly equal to the head; caudal long, the middle rays produced.

Color of male in alcohol deep brown above, mottled, and with minute dark spots and lines, some forming rings around pale spots and blotches, and traces of about six pale broad crossbars; sides of the trunk with six brown blotches; lower surface of the body white; spinous dorsal gray, with white spots and lines, and blackish near its margin posteriorly; soft dorsal gray with numerous white ocelli, and three rows of longitudinal blackish spots; anal dark gray with oblique wavy white lines; pectoral with small brown spots above; ventral grayish brown, becoming blackish along the lower margin of the fins; caudal gray, with many white ocelli and black spots, and its lower margin broadly blackish. The female differs from the male chiefly in having pale colors, the anal being very pale, the ventrals pale with a

light edge, the dorsal filaments generally shorter, and the spinous dorsal generally with more or less black posteriorly.

Here described from specimens from Tokyo, the largest $8\frac{1}{4}$ inches long. Our specimens are from Tokyo, the original types collected by Otaki, and many others taken by Jordan and Snyder. Others are from Misaki, Otaru, Wakanoura, Kobe, Hakodate, Aomori, Hiroshima, Nagasaki, and Matsushima Bay.

This species, variable in its coloration, is easily distinguished by its broad interorbital space.

This species is very abundant throughout almost all parts of Japan, being scarcely less common than *Callionymus valenciennesi*, though living in rather deeper water. The male is well distinguished by the form of the dorsal fin, the first two spines being filamentous, the others progressively shorter. A still better diagnostic mark is the color of the anal fin, which has dark gray or black oblique crossbars on the membranes. These marks are faint or wanting in the female, but in both sexes the dorsal spines are progressively shortened from the first.

(*beniteguri*, vernacular name of *Callionymus altivelis*: *beni*, red; *teguri*, net catch, a name applied to small fish.)

12. CALLIONYMUS VIRGIS Jordan and Fowler, new species.

Head 3 in length; depth $7\frac{3}{4}$; D. IV-9; A. 9; P. 19; V. 1, 5. Body elongate, compressed above, the trunk broader than deep and tapering backward. Head compressed, so that the depth is about one-half its width; snout pointed, compressed, and equal to the eye; eyes large, close together, 4 in the length, and 3 in the width of the head; mouth rather large, and the maxillary extending to within a short distance of the eye; teeth in villiform bands in the jaws; lips moderate; preopercular spine with 3 teeth above, and a short spine in front directed forward; head smooth above. Gill openings small, round, as far apart as the distance between the outer margins of the eyes, and nearer the posterior margin of the latter than the origin of the pectorals.

Origin of the spinous dorsal nearer the posterior margin of the eye by two-thirds its diameter than the origin of the soft dorsal; dorsal spines all very long, slender, and filamentous, the first and third equal, but shorter than the second and fourth, which reach the base of the caudal; the membrane of the spinous dorsal high, and joined from behind the last spine to the first dorsal ray; soft dorsal high in front and posteriorly, the margin concave or emarginate, and the last ray produced to the base of the caudal; anal low and the rays produced posteriorly, but the last not reaching the caudal; pectorals broad, the middle rays produced, with a sharp angle behind; ventrals about equal to the head; caudal subtruncate, the margin slightly convex, and the upper rays nearly as long as the middle; caudal peduncle compressed, about two-thirds the eye.

Color in alcohol brown above, with dark brown reticulating lines inclosing pale blotches and spots; below white, the sides light, with rather deep brown reticulations; spinous dorsal gray, dark in front, and behind the third and fourth spines a light vertical streak; soft dorsal pale brown, with a brown blotch at the base of each ray; anal pale, with pale brown streaks on the membrane; pectorals very pale, with small brown spots above; ventrals pale, more or less broadly

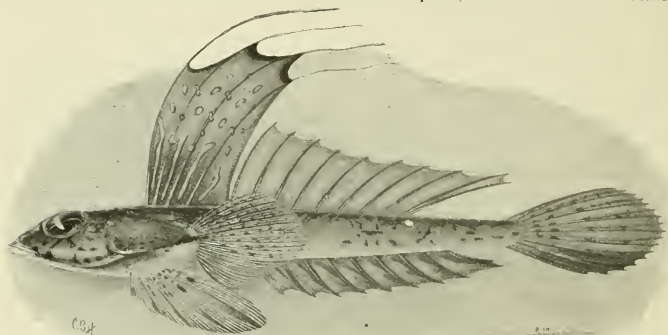


FIG. 9.—CALLIONYMUS VIRGATUS.

spotted with brown, and gray-brown, with 3 or 4 gray crossbars, and a broad blackish band along the lower edge. Described from a single small specimen $2\frac{1}{16}$ inches long, from Misaki.

Type No. 7189, Leland Stanford Junior University Museum.

This species, known only from the specimen described above, is easily distinguished from all others of the genus by its exceedingly long dorsal spines, the dorsal fins being joined together by a membrane, and the subtruncate caudal.

(*virgatus*, under the whip.)

SUMMARY.

Family I. DRACONETTIDÆ.

I. *Draconetta* Jordan and Fowler.

1. *renica* Jordan and Fowler; Suruga Bay.

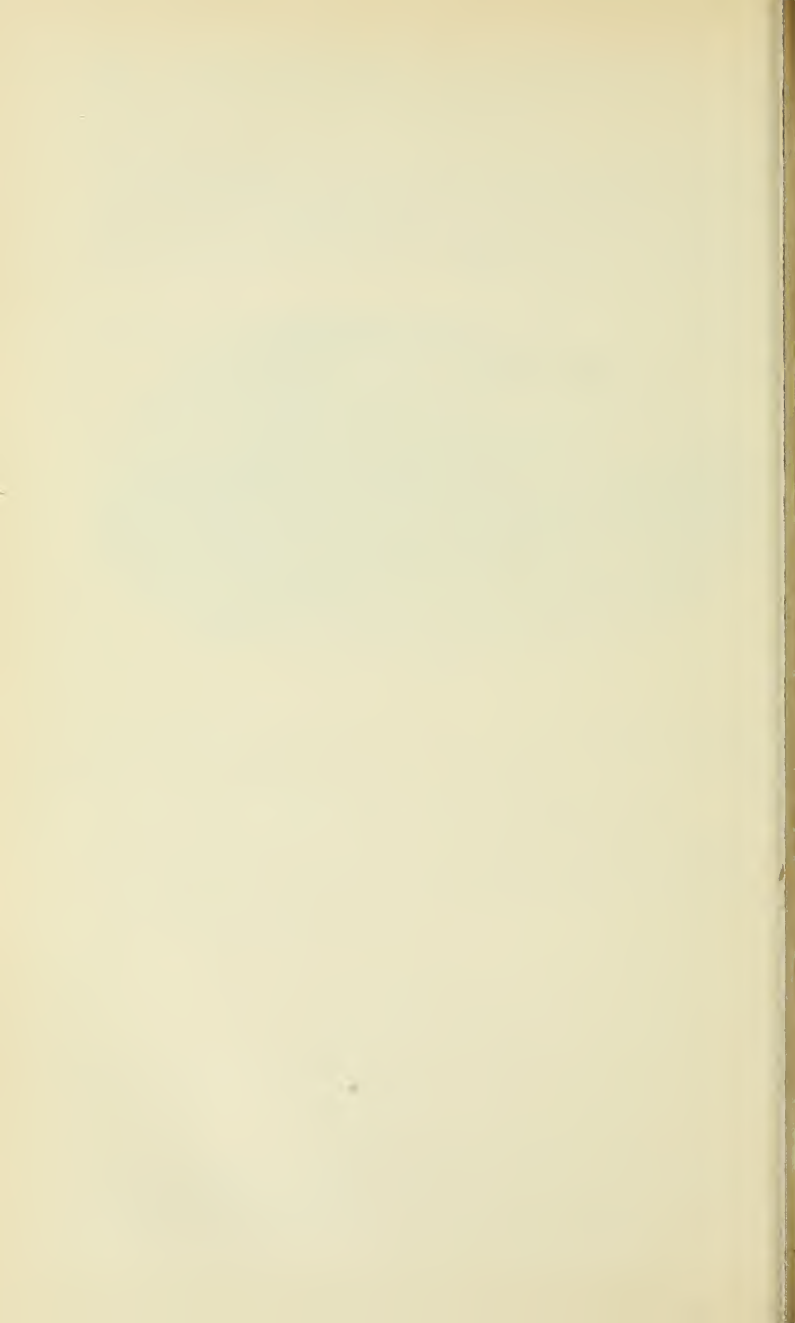
Family II. CALLIONYMIDÆ.

II. *Calliurichthys* Jordan and Fowler.

2. *japonicus* (Houttuyn); Nagasaki, Wakanoura.
3. *variegatus* (Schlegel); Nagasaki.
4. *doryssus* Jordan and Fowler; Nagasaki, Wakanoura.

III. *Callionymus* Linnaeus.

5. *altivelis* Schlegel.
6. *lunatus* Schlegel; Wakanoura, Nagasaki, Tsuruga, Same, Niigata, Hakodate.
7. *valenciennesi* Schlegel; Tsuruga, Tokyo, Yokohama, Matsushima, Misaki, Wakanoura, Enoshima, Kobe, Onomichi, Kawatana, Nagasaki.
8. *flavus* Jordan and Fowler; Aomori, Matsushima Bay, Tokyo, Kobe, Tsuruga, Nagasaki, Owari Bay, Suruga Bay.
9. *calliste* Jordan and Fowler; Misaki.
10. *huguenii* Bleeker; Nagasaki.
11. *beniteguri* Jordan and Snyder; Hakodate, Otaru, Matsushima, Tokyo, Misaki, Wakanoura, Kobe, Hiroshima, Nagasaki.
12. *virgis* Jordan and Fowler; Misaki.



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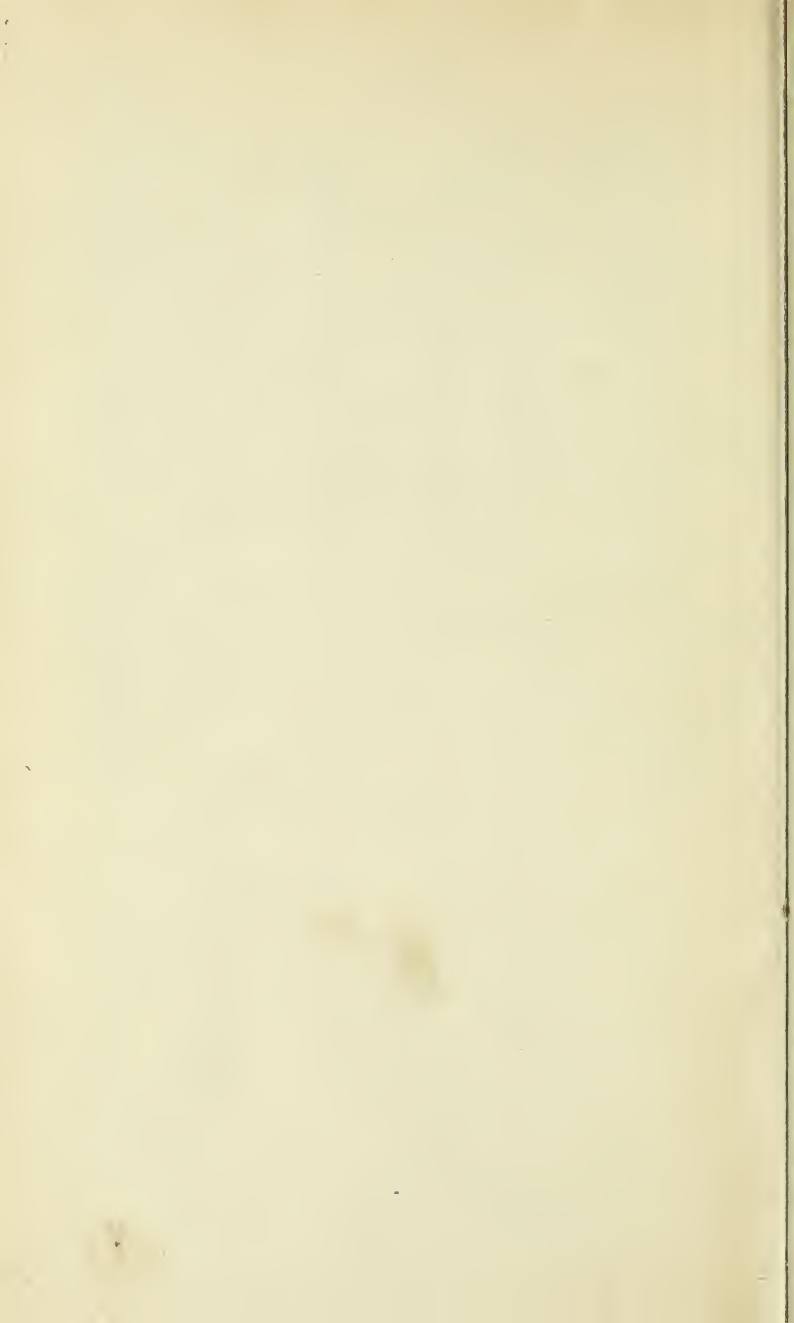
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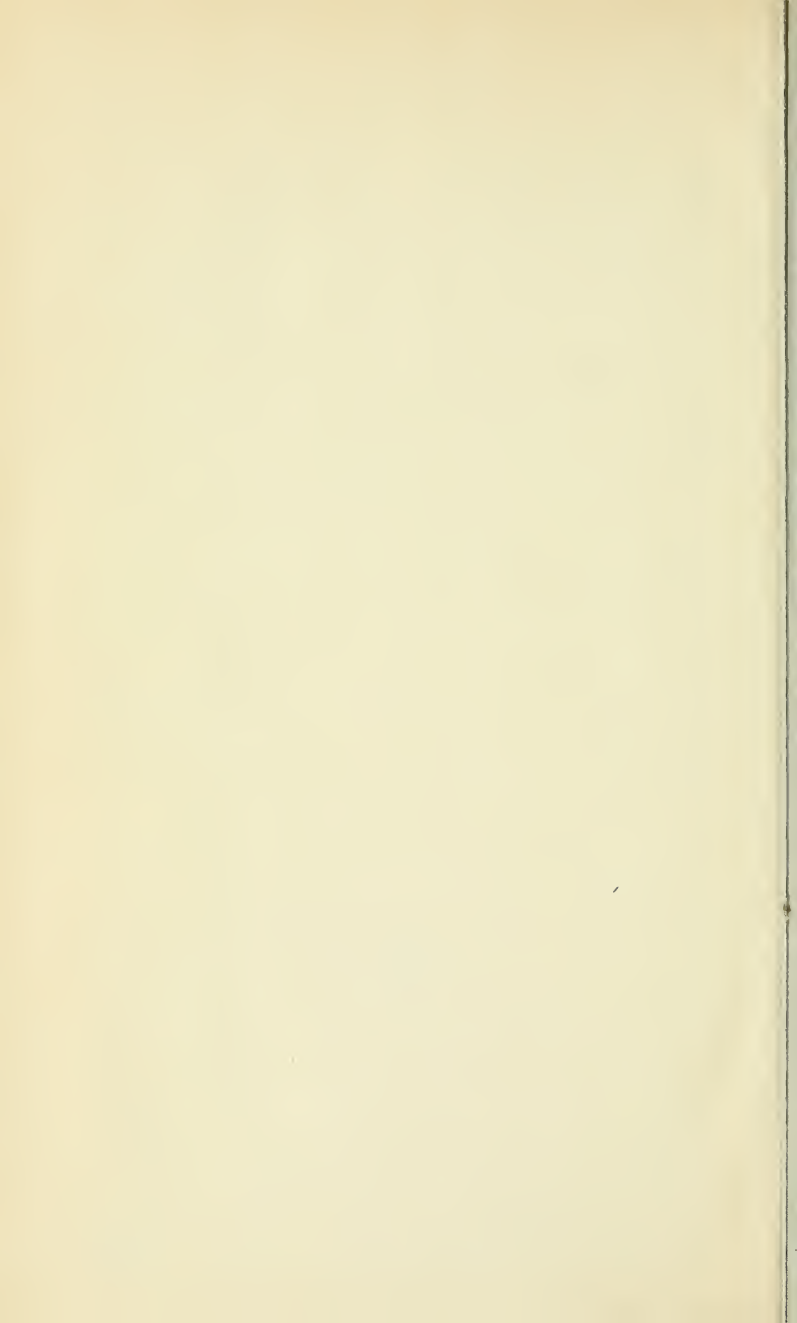
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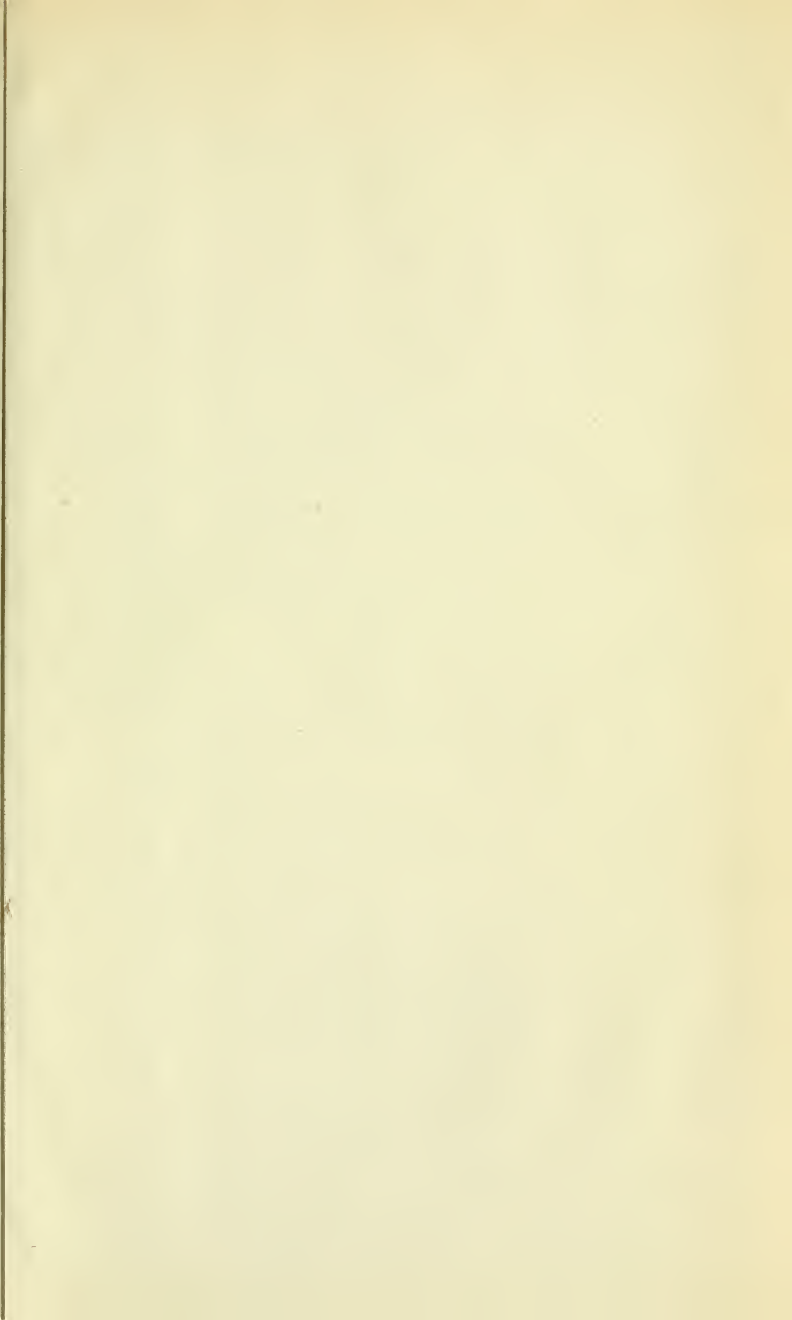
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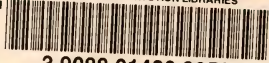




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