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A STUDY OF THE SYSTEMATIC AND GEOGRAPHICAL DISTRIBUTION
OF THE DECAPOD FAMILY ATYIDÆ Kingsley.

BY ARNOLD E. ORTMANN.

In the following paper I propose to give a revision of the family *Atyidæ* with especial reference to its geographical distribution. For a true representation of the geographical range of a group of animals it is necessary to examine the details of the distribution of all the known species, as well as to define the systematic limits of each. Every error in determining a species may be followed by great confusion difficult to solve by subsequent investigation. In revising the known genera and species it is necessary to state the relations and affinities to each other in order to get an idea of the peculiarities of the geographical distribution and to find out their cause.

The family *Atyidæ*, although a small one, comprises a considerable number of ill-defined species and genera, since most authors in creating such did not investigate their relations to those already known. In the typical genus *Atya* there are farther difficulties due to the change of characters undergone by one species in the different stages of life, which were wholly neglected by the majority of authors. I have, notwithstanding, succeeded in revising the family, pointing out the identity of certain species and genera, defining some more correctly, and stating the affinities so as to leave but a few species doubtful. I have determined a peculiar geographical distribution of the family agreeing well with its habits and morphological characters.

The family *Atyidæ* is a very characteristic one among the Decapod group of *Eucyphidea*. It shows on the one hand a number of primitive characters, on the other a very peculiar shape of the fingers of the chelæ. As I have stated in a former paper,¹ the *Atyidæ* are closely connected with the family *Acantheephyridæ*, which live at great depths in the sea and contain, without doubt, the most primitive *Eucyphidea*. The morphological differences between the two families are the following: 1. The mandible in the *Acantheephyridæ* is furnished with a palpus (synhipod), in the *Atyidæ* it is wanting.

¹ Decapoden u. Schizopoden der Plankton-Expedition, 1893, p. 42.

2. The fingers of the chelæ in the *Acantheephyridæ* are normal in shape, in the *Atyidæ* they are provided with a peculiar pencil of hairs. I may add that the habits of the two families are wholly different, the *Acantheephyridæ* being true marine animals, especially abyssal, the *Atyidæ* being true fresh-water forms.

Among the *Atyidæ* Kingsley distinguished two subfamilies, *Atyinae* and *Ephyrinae*. Since, however, there are but a few genera in this family, a subdivision is needless. The genera form a continuous series, the transition being so gradual that it is difficult to define the limits of the two subfamilies. In the following synopsis of the genera the first three named, *Xiphocaris*, *Troglocaris*, and *Atyaephyra* may be regarded as belonging to the subfamily *Ephyrinae* as created by Kingsley, the others as belonging to the *Atyinae*. Because the genus *Ephyra*, from which is derived the name *Ephyrinae*, is a synonym, this subfamily must be renamed, and I propose to name it, if at all, *Xiphocarinae*.

The presence of exopodites on the pereiopoda of the *Xiphocarinae*, the shape of the carpal and propodal joints of the first two pairs of pereiopoda, and the shape of the rostrum constitute a very close resemblance to the *Acantheephyridæ*. *Atyaephyra* makes a transition to the *Atyinae*, bearing exopodites only on the first two pairs of pereiopoda, and having the carpal joints of these legs excavated at the distal extremity. This excavation is very characteristic in the true *Atyinae*, but in *Caridina* the carpal joint only of the first pair of legs shows this peculiarity, that of the second pair being normal. *Atyoida* is intermediate between *Caridina* and *Atya* in the shape of the propodal joints of these legs. Within the limits of *Caridina* occurs a reduction of the form of the rostrum (being in the *Xiphocarinae* long and serrated), which in most species of *Caridina* is longer or shorter and serrated, in a few very short and not serrated. In *Atyoida* and *Atya* the rostrum is usually short, but now and then it bears a few teeth on the inferior margin. Thus the series formed by *Xiphocaris*, *Atyaephyra*, *Caridina*, *Atyoida*, and *Atya* is a continuous one, whilst the genus *Troglocaris* is closely allied to *Xiphocaris* differing only by the rudimentary condition of the eyes, due to its subterranean habits in cave-waters.

The genus *Atya* is the most extreme of the family. The adult males of the species of this genus attain a considerable size, and the third pereiopoda undergo with increase of age a change in shape,

the surface of the body and legs bearing a peculiar sculpture. The most extreme species, *Atya crassa*, may be separated from the others according to the sculpture of the body and placed in a separate subgenus, *Evatya*.

Fossil *Atyidæ* are not known, although A. Milne-Edwards² describes a *Caridina nitida* from the "marnes d'Aix-en-Provence" (upper eocene or lower oligocene). None of the arguments given by him prove that this fossil is a *Caridina*. The presence in a fresh-water deposit makes it probable that it belongs to *Atyidæ*, but for the same reason *Homelys minor* of Meyer,³ from the fresh-water deposits of the upper miocene of Eningen, would belong to the same family.

ATYIDÆ Kingsley, 1879.

Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1879, p. 414. Bate, Challenger Macrur., 1888, p. 691. Ortmann, Zoolog. Jahrb., V, 1890, p. 455.

Mandibles stout, crown broad, dilated, slightly divided, without a synhipod. First four pairs of pereopoda with epipodites. First two pairs of pereopoda chelate, nearly equal, carpus of the second not annulated. Tips of fingers with pencils of hairs. Rostrum longer or shorter, serrated or not serrated.

*a*₁. Pereopoda with exopodites [*Xiphocarinae*].

*b*₁. All the pereopoda with exopodites. Carpal joints of the first two pairs of pereopoda not excavated or but indistinctly so.

*c*₁. Eyes well developed XIPHOCARIS.

*c*₂. Eyes rudimentary TROGLOCARIS.

*b*₂. Only the first two pairs of pereopoda with exopodites. Carpal joints of the first and second pair of pereopoda distally excavated ATYAEPHYRA.

*a*₂. Pereopoda without exopodites [*Atyinae*].

*b*₁. Carpal joint of the second pereopoda normal, not excavated. Rostrum mostly compressed and serrated . . . CARIDINA.

*b*₂. Carpal joint of the second pereopoda like that of the first distally excavated.

*c*₁. Movable finger shorter than the immovable part of hand, the latter distinctly divided in a palmar portion and an immovable finger ATYOIDA.

*c*₂. Both fingers alike in size, no palma developed . ATYA.

² Bull. Soc. Philomat., Paris (7), II, 1879, p. 77.

³ Palæontographica, X, 3, 1862, p. 172, pl. 19, figs. 3-8.

XIPHOCARIS v. Martens, 1872.

Ephyra de Haan, Faun. Japon., Crust., Dec. 6, 1849, p. 185.⁴ (Nomen præoccupatum.)

Xiphocaris v. Martens, Archiv f. Naturg., 38, 1, 1872, p. 139.

Miersia Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1879, p. 416.

Xiphocaris Kingsley, Bull. Essex Instit., vol. 14, 1882, p. 127.

Paratya Miers, Annal. Mag. Nat. Hist. (5), IX, 1882, p. 194.

Xiphocaris Pocock, Annal. Mag. Nat. Hist. (6), III, 1889, p. 17.

Miersia Ortmann, Jenaische Denkschr., VIII, 1894, p. 8.

- a*₁. No supraocular spines. Rostrum longer or shorter, with an interrupted series of teeth on the upper margin, the basal series containing 9-18, the apical 3-6 teeth. Lower margin of rostrum with numerous (16-40) teeth *X. elongata*.

SUBSPECIES (or varieties).

- b*₁. Rostrum longer than carapace . . . *X. elongata typica* (1).⁵

- b*₂. Rostrum shorter than carapace.

- c*₁. Rostrum longer than the scaphocerite.

- *X. elongata intermedia* (1).

- c*₂. Rostrum longer than the stalk of antennulæ.

- *X. elongata gladiator*.

- c*₃. Rostrum shorter than the stalk of antennulæ.

- *X. elongata brevirostris*.

- a*₂. Supraocular spines present. Rostrum about as long as the scaphocerites or somewhat longer. An uninterrupted series of 20-24 teeth on the upper, 2-4 teeth on the lower margin.

- *X. compressa* (3).

1. *Xiphocaris elongata* (Guérin), 1857.

Hippolyte elongata Guérin, Anim. Artic. in: Ramon de la Sagra, Hist. de l'île de Cuba, 1857, p. 54, pl. 2, fig. 16.

Oplophorus americanus Saussure, Mem. Soc. Phys. Hist. Nat. Genève, t. 14, 2, 1858, p. 472, pl. 4, fig. 31.

Xiphocaris elongata (Guér.) v. Martens, Arch. f. Naturg., 38, 1, 1872, p. 140.

Oplophorus elongata (Guér.) Kingsley, Bull. Essex Instit., X, 1878, p. 68.

Xiphocaris elongata (Guér.) Pocock, Ann. Mag. Nat. Hist. (6), III, 1889, p. 17 ff, pl. 2, figs. 5-8.

Xiphocaris gladiator, var. *intermedia*, *brevirostris* Pocock, ibid.

Oplophorus elongatus (Guér.) Sharp, Proceed. Acad. Nat. Sci., Philadelphia, 1893, p. 121.

Geographical distribution: Fresh-waters of the Antilles.—Cuba (Guérin, v. Martens); Hayti (Saussure); Dominica (Pocock); St. Domingo (Sharp).

2. *Xiphocaris compressa* (de Haan), 1849.

Ephyra compressa de Haan, Faun. Japon. Crust., Dec. 6, 1849, p. 186, pl. 46, fig. 7.

Atyephyra compressa (d. H.) v. Martens, Arch. f. Naturg., 34, 1, 1868, p. 51 ff, pl. 1, fig. 4.

Atyephyra compressa (d. H.) Miers, Ann. Mag. Nat. Hist. (5), IX, 1882, p. 193.

⁴ Non *Ephyra* Roux, Memoir. Salicoques, 1831, p. 24, which is identical with *Acanthephyra* A. Milne-Edwards, and belongs to the *Acanthephyridæ*.

⁵ I put in parentheses following each species, the number of specimens I have examined myself.

Miersia compressa (d. H.) Ortmann, Zoolog. Jahrb., V, 1890, p. 463.

Miersia compressa (d. H.) Ortmann, Jenaisch. Denkschr., VIII, 1894, p. 8.

Geographical distribution: Fresh-water of Australasia.—Japan (de Haan); Yokohama (v. Martens), Tokio (Miers, Ortmann); Island of Adenare, near Flores (v. Martens); Queensland: Burnett (Ortmann).

TROGLOCARIS Dormitzer, 1853. Dormitzer, Lotos, III, 1853, p. 85.

Only one species known, distinguished from *Xiphocaris* by the rudimentary condition of the eyes. Supraocular spines present.

1. *Troglocaris schmidtii* Dormitzer, 1853.⁶

Dormitzer, *ibid.*, p. 85 ff, pl. 3.

Geographical distribution: In the waters of the caves of Carniola. Caves of Kumpole and Gurk (Dormitzer).

ATYAËPHYRA Brito-Capello, 1866.

Atyaëphyra Brito-Capello, Descr. Esp. nov. Crust. Arachn., Portugal, Lisboa, 1866, p. 5.

Hemicaridina Ortmann, Zoolog. Jahrb., V, 1890, p. 464.

Only one species known.

1. *Atyaëphyra desmarestii* (Millet) 1832 (16).

Hippolyte desmarestii Millet, Annal. Sci. Nat., t. 25, 1832, p. 461, pl. 10 B.

Hippolyte desmarestii Millet, Milne-Edwards, Hist. Nat. Crust., II, 1837, p. 376.

Caridina desmarestii (Mill.) Joly, Annal. Sci. Nat. (2), Zool., t. 19, 1843, p. 34 ff, pl. 3.

Caridina desmarestii (Mill.) Heller, Crust. südl. Europ., 1863, p. 238, pl. 8, fig. 3.

Atyaëphyra rosiana Brito-Capello, Descr. esp. nov. Crust. Arachn., Portugal, Lisboa, 1866, p. 6, pl. 1, fig. 1.

Hemicaridina desmarestii (Mill.) Ortmann, Zoolog. Jahrb., V, 1890, p. 464.

Geographical distribution: Fresh-water of southern Europe.—Portugal: Coimbra (Brito-Capello); southern and western France (Millet, Joly); Corsica, Sicily, Dalmatia (Heller).

CARIDINA Milne-Edwards, 1837.

Caridina Milne-Edwards, Hist. Nat. Crust., II, 1837, p. 362.

Caradina Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1879, p. 415.

*a*₁. Rostrum longer or shorter, serrated. Anterior margin of carapace with an antennal-spine.

*b*₁. Upper margin of rostrum not serrated. Carpal joint of the first pereopoda but slightly longer than broad *C. typus* (2).

. *C. americana*.⁷

⁶ There is no doubt that the *Palæmon anophthalmus* Kollar, Sitz. Ber. Akad. Wiss., Wien, I, 1848, p. 137, from the caves of Kompoljska and Portiskavez in Carniola is the same species as *Troglocaris schmidtii*. As there is no published description by Kollar, the name *anophthalmus* cannot be employed.

⁷ *C. americana* is a somewhat doubtful species, but certainly it is closely allied to *C. typus*.

- b*₂. Upper margin of rostrum serrated.
- c*₁. Carpal joint of the second pereiopoda shorter than the hand, carpal joint of the first pereiopoda short. Rostrum about as long as the antennal scale. *C. brevicarpalis* (1).
- c*₂. Carpal joint of the second pereiopoda longer than the hand.
- d*₁. Rostrum horizontally projecting or slightly deflexed, shorter than the antennal scale.
- e*₁. Carpal joint of the first pereiopoda short, not more than $1\frac{1}{2}$ as long as broad.
- f*₁. Lower margin of rostrum serrated.
- g*₁. Upper margin of rostrum with about 13-20 teeth, rostrum mostly longer than the first joint of the antennulæ.
- h*₁. Eggs small and numerous. Fingers of the second pereiopoda twice as long as the palm.
- i*₁. Carpal joint of the first pereiopoda distinctly longer than broad *C. weberi*.
- i*₂. Carpal joint of the first pereiopoda nearly as broad as it is long *C. japonica*.
- h*₂. Eggs greater and not numerous. Fingers of the second pereiopoda but slightly longer than the palm. *C. pareparensis*.
- g*₂. Upper margin of rostrum with 3-5 teeth; rostrum as long or a little longer than the first joint of the antennulæ. *C. timorensis*.
- g*₃. Upper margin of rostrum with 7-12 teeth; rostrum shorter than the first joint of the antennulæ. *C. parvirostris*.
- f*₂. Lower margin of rostrum not serrated. . . . *C. richtersi*.
- e*₂. Carpal joint of the first pereiopoda longer, at least twice as long as broad.
- f*₁. Spine at the base of the antennulæ shorter than the first joint.
- g*₁. Dactylus of the fifth pereiopoda nearly half as long as the propodus. *C. lævis*.
- g*₂. Dactylus of the fifth pereiopoda very short, $\frac{2}{5}$ - $\frac{1}{7}$ of the propodus.
- h*₁. Rostrum shorter than the stalk of the antennulæ, upper margin with 20-30 teeth, lower with 5-14. *C. multidentata*.
- h*₂. Rostrum about as long as the stalk of the antennulæ.
- i*₁. Teeth of the upper margin of rostrum 10-15, not continued to the tip of rostrum, on the tip 1-2 teeth, on the lower margin 7-12. *C. africana* (many).
- i*₂. Teeth of the upper margin of rostrum 20-25, in a continuous series to the tip. *C. fossarum*.

- f_2 . Spine at the base of the antennulæ longer than the first joint *C. serratirostris*.
- d_2 . Rostrum slightly bent upward, longer than the antennal scale. Upper margin partially destitute of teeth.
- e_1 . The proximal teeth on the upper margin of rostrum crowded, numerous.
- f_1 . Carpal joint of the first pereopoda a little shorter than the hand.
- g_1 . Carpal joint of the first pereopoda $2-2\frac{1}{2}$ as long as broad *C. wycki* (many).
- g_2 . Carpal joint of the first pereopoda only $1\frac{1}{2}$ as long as broad *C. nilotica* (1).
- f_2 . Carpal joint of the first pereopoda very much shorter than the hand *C. grandirostris*.
- e_2 . The proximal teeth on the upper margin of rostrum remote, not numerous *C. gracilirostris*.
- a_2 . Rostrum very short, not serrated. Anterior margin of the carapace without an antennal spine.
- b_1 . Fingers of the first pereopoda about as long as the palm. *C. singhalensis* (many).
- b_2 . Fingers of the first pereopoda much shorter than the palm. *C. brevirostris*.

1. *Caridina typus* Milne-Edwards, 1837.⁸

Caridina typus Milne-Edwards, Hist. Nat. Crust., II, 1837, p. 363, pl. 25 bis, figs. 4, 5.

C. exilirostris Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 29.

C. siamensis Giebel, Zeitschr. f. d. ges. Naturw., 21, 1863, p. 329.

C. typus M. E., Miers, Philosoph. Trans. London, 168, 1879, p. 492. Richters, Beitr. Meeresfaun. Maurit. Seychell. Decap., 1880, p. 162, pl. 17, fig. 23.

C. typus M. E., de Man, in Weber, Zoolog. Ergebn. Reis. Niederl. Ost-Indien, II, 1892, p. 367, pl. 21, fig. 22.

C. typus M. E., de Man, Not. Leyd. Mus., 15, 1893, p. 300.

C. typus M. E., Sharp, Proceed. Acad. Nat. Sci., Philadelphia, 1893, p. 111.

C. typus M. E., Ortmann, Jenaische Denkschr., VIII, 1894, p. 8.

Geographical distribution: Fresh-water of the Islands of the Indian Ocean and of Indo-Malaysia.—Mauritius (Richters, Sharp); Rodriguez (Miers); Seychelles (Richters); Siam (Giebel); Flores, Timor, Saleyer, Celebes (de Man); Amboina (Ortmann); Loo-Choo (Stimpson).

2. *Caridina americana* Guérin, 1857.

Guérin, Anim. Artic. in Ramon de la Sagra, Hist. de l'île de Cuba, 1857, p. 52, pl. 2, fig. 13.

v. Martens, Arch. f. Naturg., 38, 1, 1872, p. 135.

Pocock, Ann. Mag. Nat. Hist. (6), III, 1889, p. 16, pl. 2, fig. 4.

Geographical distribution: Cuba (Guérin, v. Martens); Dominica (Pocock).

⁸ *Caridina typus* Bate, Challenger Macr. 1888, p. 704, pl. 119, fig. 3, from San Jago, Cape Verde Isl. is probably a different species.

3. *Caridina brevicarpalis* de Man, 1892.

De Man, in: Weber, Zool. Erg., etc., II, 1892, p. 397, pl. 24, fig. 30.
Ortmann, Jenaische Denkschr., VIII, 1894, p. 9.

Geographical distribution: Celebes (de Man); Amboina (Ortmann).

4. *Caridina weberi* de Man, 1892.

De Man, in: Weber, Zool. Erg., etc., II, 1892, p. 371, pl. 22, fig. 23.
De Man, Not. Leyden Mus., 14, 1892, pl. 9, fig. 8.

Geographical distribution: Sumatra; Java; Saleyer; Celebes; Flores (De Man).

5. *Caridina japonica* de Man, 1892.

De Man, Not. Leyd. Mus., 14, 1892, p. 261, pl. 9, fig. 7.

Geographical distribution: Japan: Kagar, Hayagana (De Man).

6. *Caridina pareparensis* de Man, 1892.

De Man, in: Weber, Zool. Erg., etc., II, 1892, p. 379, pl. 22, fig. 25.

Geographical distribution: Celebes (De Man).

7. *Caridina timorensis* de Man, 1893.

De Man, Not. Leyd. Mus., 15, 1893, p. 300, pl. 8, fig. 6.

Geographical distribution: Timor (De Man).

8. *Caridina parvirostris* de Man, 1892.

De Man, in: Weber, Zool. Ergebn., etc., II, 1892, p. 375, pl. 22, fig. 24.

Geographical distribution: Flores (De Man).

9. *Caridina richtersi* Thallwitz, 1891.

C. serrata Richters, Beitr. Meeresf. Maur. Seych. Decap., 1880, p. 163, pl. 17, figs. 24-27 (nomen præoccupatum).

C. richtersi Thallwitz, Abhandl. Mus. Dresden, 3, 1891, p. 27, foot-note.

Geographical distribution: Mauritius (Richters).

10. *Caridina lævis* Heller, 1862.

Heller, Sitz. Ber. Acad. Wiss., Wien, 45, 1, 1862, p. 411.

De Man, in: Weber, Zool. Ergebn., etc., II, 1892, p. 376, pl. 23, fig. 27.

Geographical distribution: Java (Heller, De Man).

11. *Caridina multidentata* Stimpson, 1860.

Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 29.

De Man, in: Weber, Zool. Ergebn., etc., II, 1892, p. 380, pl. 22, fig. 26.

Geographical distribution: Bonin Isl. (Stimpson); Celebes (De Man).

12. *Caridina africana* Kingsley, 1882.⁹

Kingsley, Bull. Essex Instit., vol. 14, 1882, p. 127, pl. 1, fig. 3.

Geographical distribution: S. Africa: Zulu Land (Kingsley).

⁹ Having examined the types of this species in the Museum of the Academy of Nat. Sci., Philadelphia, I can give the following details:—

Carpal joint of the first pereopoda twice as long as broad on the distal extremity, a little shorter than the hand. Fingers about equal to the palm. Carpal joint of the second pereopoda four times as long as broad on the distal extremity, a little longer than the hand. Fingers about $1\frac{1}{2}$ as long as the palm. Dactylus of the fourth pereopoda about 1.5 of the propodus, the fifth pereopoda are in none of the type specimens preserved.

13. *Caridina fossarum* Heller, 1862.

Heller, Sitzb. Acad. Wiss., Wien, 45, 1, 1862, p. 411.

De Man, in: Weber, Zool. Ergebn., etc., II, 1892, p. 397.

Geographical distribution: Persia: Schiraz (Heller).14. *Caridina serratirostris* de Man, 1892.

De Man, in: Weber, Zool. Ergebn., etc., II, 1892, p. 382, pl. 23, fig. 28.

Geographical distribution: Flores; Saleyer; Celebes (De Man).15. *Caridina wycki* (Hickson), 1888.*Atya wycki* Hickson, Annal. Mag. Nat. Hist. (6), II, 1888, p. 357, pl. 13, 14.*Caridina wycki* (Hicks.) Thallwitz, Abhandl. Mus. Dresden, 3, 1891, p. 27.*Caridina wycki* (Hicks.) de Man, in: Weber, Zool. Ergebn., etc., II, 1892, p. 386, pl. 24, fig. 29-29k.*Caridina wycki* (Hicks.) de Man, Not. Leyden Mus., 15, 1893, p. 302, pl. 8, fig. 7.*Caridina wycki* (Hicks.) Ortmann, Jenaische Denkschr., VIII, 1894, p. 9.*Geographical distribution*: From East-Africa to eastern Australia.

—East-Africa: Dar-es-Salaam (Ortmann); Ceylon (Ortmann); Celebes (Hickson, Thallwitz, de Man); Saleyer (de Man); Flores (de Man); Timor (de Man); Queensland: Burnett (Ortmann).

16. *Caridina nilotica* (Roux), 1833.¹⁰*Pelias niloticus* Roux, Annal. Sci. Nat., t. 28, 1833, p. 73, pl. 7, fig. 1.*Caridina longirostris* Milne-Edwards, Hist. Nat. Crust., II, 1837, p. 363.*Caridina longirostris* Lucas, Explor. Alger. Anim. Artic., 1849, p. 40, pl. 4, fig. 1.*Caridina longirostris* Heller, Sitzb. Acad. Wiss., Wien, 45, 1, 1862, p. 412.*Caridina longirostris* de Man, in: Weber, Zool. Ergebn., etc., II, 1892, p. 396, pl. 24, fig. 29l, 29m, 29mm.*Caridina longirostris* Sharp, Proceed. Acad. Nat. Sci., Philadelphia, 1893, p. 111.*Geographical distribution*: Northern Africa.—Nile (Roux); Algiers (Lucas, Sharp); River Macta, near Oran (Milne-Edwards).17. *Caridina grandirostris* Stimpson, 1860.

Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 28.

Geographical distribution: Loo-Choo (Stimpson).18. *Caridina gracilirostris* de Man, 1892.

De Man, in Weber, Zoolog. Ergebn., etc., II, 1892, p. 399, pl. 25, fig. 31.

Geographical distribution: Sumatra, Celebes, Saleyer, Flores (De Man).19. *Caridina singhalensis* Ortmann, 1894.

Ortmann, Jenaische Denkschr., VIII, 1894, p. 9, pl. 1, fig. 2.

Geographical distribution: Ceylon (Ortmann).¹⁰ It is doubtful, whether the following quotations belong to this species or to *Car. wycki*:*C. nilotica* Hilgendorf, Mon. Ber. Akad. Wiss., Berlin, 1878, p. 828.—Mozambique, Tette.*C. longirostris* Richters, Beitr. Meeresf. Maur. Seych. Decap., 1880, p. 162.—Seychelles.*C. nilotica* Pfeffer, Jahrb. Hamburg Wiss. Anstalt., VI, 1889, p. 35.—Zanzibar.

20. *Caridina brevirostris* Stimpson, 1860.

Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 29.

Geographical distribution: Loo-Choo (Stimpson).DOUBTFUL SPECIES.¹¹*Caridina denticulata* de Haan, Faun. Japon. Crust., Dec. 6, 1849, p. 186, pl. 45, fig. 8.—Japan.*Caridina leucosticta* Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 28.—Japan, Simoda.*Caridina serrata* Stimpson, *ibid.*, p. 29.—Hongkong.*Caridina acuminata* Stimpson, *ibid.*, p. 29.—Bonin Isl.*Caridina spathulirostris* Richters, Beitr. Meeresf. Maur. Seych., 1880, p. 163, pl. 17, fig. 28.—Mauritius.*Caridina curvirostris* Heller, 1862.

Heller, Verhandl. Zool. Bot. Gesellsch., Wien, 12, 1862, p. 525.

Heller, Crust. Novara, 1868, p. 105.

Miers, Catal. Crust. New Zealand, 1876, p. 78.

Geographical distribution: Auckland (Heller).

This species is provided with an supraorbital and an antennal spine, the spine at the base of the antennulæ is longer than the first joint.

It may belong to the genus *Xiphocaris* and may be identical with a species of *Xiphocaris* from the River Avon, near Christ Church, present in the Museum of Strassburg. Unfortunately I cannot give a description of these specimens and a comparison with Heller's species.

ATYOIDA Randall, 1839.

Randall, Journ. Acad. Nat. Sci., Philadelphia, VIII, 1839, p. 140.

This genus¹² has, up to the present time, been very doubtful. Examining specimens of *Atyoida bisulcata* from Oahu, Sandwich, in the Museum of the Academy of Natural Sciences of Philadelphia (No. 162), I find that the hands of the two anterior pairs of legs are wholly different from the typical *Atya*, in the same manner as figured by F. Müller in *Atyoida potimirim* (l. c., figs. 3 and 4). In

¹¹ The following three species described by Bate do not belong to *Caridina*; but to the family *Hippolytidae*:—

Caridina truncifrons Bate, Proceed. Zool. Soc. London, 1863, p. 499, pl. 40, fig. 2, belonging to *Latreutes*.

Caridina cincinnuli Bate, *ibid.*, p. 500, pl. 40, fig. 3, and *Caridina tenuirostris* Bate, *ibid.*, p. 501, pl. 40, fig. 4, both belonging to *Virbius*. (All three from Australia, St. Vincents Gulf.)

¹² *Atya serrata* Bate, Challenger Macrur., 1888, p. 699, pl. 119, fig. 2, from San Jago, Cape Verd Isl., and some other species described from the West Indies (see below), may belong to this genus. In *A. serrata* the rostrum is shorter and dentate below.

Atyoida the hands are formed like those of *Caridina*: the dactylus (movable finger) is inserted on the upper margin of the propodus, being shorter than the latter and forming a chela, as usual in the Decapoda, consisting of a palmar portion and two fingers. In *Atya*, on the contrary, the dactylus articulates with the propodus on the posterior end of the latter, both joints being exactly alike and forming a hand of a very peculiar shape among the Decapoda, the palmar portion being wholly reduced, and the hand consisting only of two fingers about alike in size, and connected with each other at the posterior ends. The carpal joint of the chelipeds in *Atyoida* is longer than in *Atya*, especially on the second pair of legs.

- α_1 . Rostrum dentate below. Carpal joint of the first pair of pereopoda longer than broad *A. potimirim*.
 α_2 . Rostrum not dentate below. Carpal joint of the first pair of pereopoda not longer than broad *A. bisulcata* (many).

1. *Atyoida potimirim* F. Müller, 1881.

F. Müller, Kosmos (Krause), IX, 1881, p. 117 ff, figs. 1-20.

Geographical distribution: Brazil: Itajahy (F. Müller).

2. *Atyoida bisulcata* Randall, 1839.

Atyoida bisulcata Randall, Journ. Acad. Nat. Sci., Philadelphia, VIII, 1839, p. 140, pl. 5, fig. 5.

Atyoida bisulcata Dana, U. S. Expl. Exp. Crust., 1852, p. 540, pl. 34, fig. 1.

Atyoida bisulcata Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 28.

Atyoida tahitensis Stimpson, ibid.

Atyoida bisulcata and *tahitensis* A. Milne-Edwards, Annal. Soc. Entomol., France (4), IV, 1864, pp. 151 and 152.

Atya bisulcata (Rand.), Bate, Challenger Macrur., 1888, p. 700, pl. 120.

Atya bisulcata (Rand.), Sharp, Proceed. Acad. Nat. Sci., Philadelphia, 1893, p. 111.

Geographical distribution: Hawaiian Isl. (Randall, Stimpson): Oahu (Dana, Sharp); Tahiti (Stimpson).

ATYA Leach, 1817.

Atys Leach, Trans. Linn. Soc. London, XI, 1815, p. 345 (nomen præoccupatum).

Atya Leach, Zoolog. Miscell., III, 1817, p. 29.

- α_1 . Rostrum shorter than the antennular peduncle, without teeth on the upper margin [Subgenus *Atya*].
 b_1 . Rostrum without lateral keels and without lateral teeth near the base.
 c_1 . Rostrum longer than the first joint of the antennulæ, horizontally projecting or sometimes bent upward.
. *A. moluccensis* (6).
 c_2 . Rostrum as long as or shorter than the first joint of the antennulæ, bent downward. *A. spinipes*¹³ (12).

¹³ *A. spinipes* might be regarded as a variety of *A. moluccensis*.

- b_2 . Rostrum with lateral keels ending by angles or short spines on each side of the base of rostrum.
- c_1 . Carapace not sculptured with keels, but often punctate. Third pair of legs (in the adult) without a spine on the inferior margin.
- d_1 . Rostrum very short. Lateral keels ending in front in angles, not in spines.
 *A. brevirostris* (3).
- d_2 . Rostrum longer. Lateral keels ending in front in spiniform angles.
- e_1 . Merus of the first two pairs of pereiopoda hairy.¹⁴
- f_1 . Rostrum straight.
 ?*A. margaritacea* (3).
- f_2 . Rostrum bent downward.
 ?*A. robusta*.
- e_2 . Merus of the first two pairs of pereiopoda not hairy (?) *A. scabra* (3).
- c_2 . Carapace strongly sculptured in front with keels. Third pair of legs on the inferior margin with a spine in adult specimens.¹⁵ . . . *A. gabonensis* (1).
- a_2 . Rostrum as long as the antennal scale, upper margin with six to eight spines. Anterior part of carapace with numerous spines and spiny carinations [Subgenus: *Evatya* Smith]
 *A. (Evatya) crassa*.

1. *Atya moluccensis* de Haan, 1849.

- A. moluccensis* de Haan, Faun. Japon. Crust., Dec. 6, 1849, p. 186.
- A. armata* A. Milne-Edwards, Annal. Soc. Entomol., France (4), IV, 1864, p. 149, pl. 3, fig. 3.
- A. armata* v. Martens, Arch. f. Naturg., 34, 1, 1868, p. 47, pl. 1, fig. 6.
- A. moluccensis* d. H., Miers, Annal. Magaz. Nat. Hist. (5), V, 1880, p. 382, pl. 15, fig. 3, 4.
- A. gustavi* Ortmann, Zoolog. Jahrb., V, 1890, p. 467, pl. 36, fig. 9.
- A. dentirostris* Thallwitz, Abhandl. Mus., Dresden, 3, 1891, p. 26, fig. 7.
- A. moluccensis* d. H., de Man, in Weber, Zoolog. Ergebn. Reis. Niederl. Ost-Indien, II, 1892, p. 357, pl. 21, fig. 20.
- A. moluccensis* d. H., Ortmann, Jenaische Denkschr., VIII, 1894, p. 10.

Geographical distribution: Fresh-water of the Indian Archipelago.—Sumatra (de Man, Ortmann); Java (A. Milne-Edwards,¹⁶ Miers, de Man); Batjan (Miers); Bali (Miers); Celebes (Miers, de Man,

¹⁴ The differences between the New Caledonian species *A. margaritacea* and *robusta* and the West Indian *A. scabra* are very doubtful, since the anterior pereiopoda of the latter have the merus furnished with a few hairs. I suppose that the locality given by Milne-Edwards for *margaritacea* and *robusta* is not correct, and that there is no difference from *A. scabra*. (See below.)

¹⁵ I think the differences of *A. gabonensis* and perhaps also of *A. crassa* are not of specific value, but that they are differences of age: *A. gabonensis* would be a very old state of *A. scabra*, but it may be that *A. crassa* is a distinct species.

¹⁶ A. Milne-Edwards records his specimens, i. e., erroneously from the Philippine Islands (see de Man, l. c., p. 357, foot-note).

Thallwitz); Saleyer (de Man); Ceram (v. Martens); Timor (de Man); Flores (de Man); Amboina (Ortmann); Philippine Islands: Samar (v. Martens).

2. *Atya spinipes* Newport, 1847.

A. spinipes Newport, Annal. Magaz. Nat. Hist., XIX, 1847, p. 159.

A. pilipes Newport, *ibid.*, p. 160.

A. spinipes and *pilipes* Newp., A. Milne-Edwards, Annal. Soc. Entomol., France (4), IV, 1864, pp. 149, 150.

A. pilipes Newp., Miers, Catal. Crust., New Zealand, 1876, p. 79.

A. spinipes and *pilipes* Newp., Miers, Annal. Magaz. Nat. Hist. (5), V, 1880, p. 282, pl. 15, figs. 5, 6.

A. pilipes Newp., Ortmann, Zoolog. Jahrb., V, 1890, p. 466, pl. 36, fig. 8.

Geographical distribution: This species represents the *A. moluccensis* in the fresh-water of the Pacific Islands.—Philippine Islands (Newport); Caroline Isl. (Ortmann); Fiji Isl. (Ortmann); Samoa Islands (Newport, Miers, Ortmann).¹⁷

3. *Atya brevirostris* de Man, 1892.

De Man, in: Weber, Zoolog. Ergebn., etc., II, 1892, p. 360, pl. 21, fig. 21.

Ortmann, Jenaische Denkschr., VIII, 1894, p. 10.

Geographical distribution: Flores (De Man); Timor (De Man); Amboina (Ortmann).

?4. *Atya margaritacea* A. Milne-Edwards, 1864.

A. Milne-Edwards, Annal. Soc. Entomol., France (4), IV, 1864, p. 148, pl. 3, fig. 2.

Ortmann, Zoolog. Jahrb., V, 1890, p. 465, pl. 36, fig. 7.

Geographical distribution: New Caledonia (A. Milne-Edwards).

?5. *Atya robusta* A. Milne-Edwards, 1864.

A. Milne-Edwards, *ibid.*, 1864, p. 148, pl. 3, fig. 1.

Geographical distribution: New Caledonia (A. Milne-Edwards).

6. *Atya scabra* Leach, 1815.

Atya scabra Leach, Trans. Linn. Soc. London, XI, 1815, p. 345.

Atya scabra Leach, Zoolog. Miscell., III, 1817, p. 29, pl. 131.

Atya scabra Desmarest, Consider. Génér. Crust., 1825, p. 217.

A. mexicana Wiegmann, Arch. f. Naturg., II, 1, 1836, p. 145.

A. scabra Leh., Milne-Edwards, Hist. Natur. Crust., II, 1837, p. 942, pl. 24, figs. 15–19, and Atlas, Cuvier's Regn. anim., pl. 51, fig. 4.

A. sulcatipes Newport, Annal. Magaz. Nat. Hist., XIX, 1847, p. 159, pl. 8, fig. 1.

A. occidentalis Newport, *ibid.*

A. scabra Leh., Stimpson, Boston Journ. Nat. Hist., VI, 1857, p. 498.

A. scabra, *sulcatipes*, and *occidentalis* A. Milne-Edwards, Annal. Soc., Entomol., France (4), IV, 1864, pp. 146, 147.

A. rivalis and *tenella* Smith, 2 and 3 Rep. Peabody Acad. Sci., 1871, p. 94.

A. scabra and *occidentalis* v. Martens, Arch. f. Naturg., 38, 1, 1872, p. 135.

A. punctata Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1878, p. 91.

A. occidentalis Newp., Kingsley, *ibid.*, p. 92.

A. sulcatipes Newp., Bate, Challenger Macrur., 1888, p. 694, pl. 118, 119, fig. 1.

A. occidentalis Newp., Pocock, Annal. Mag. N. H. (6), III, 1889, p. 11, pl. 2, fig. 3.

A. scabra Leh., Sharp, Proceed. Acad. Nat. Sci., Philadelphia, 1893, p. 111.

¹⁷ The locality, "New Zealand," given by Newport is an error.

Geographical distribution: Fresh-water of the West Indies and the Cape Verde Islands. — Mexico (Wiegmann, Milne-Edwards, v. Martens, Stimpson, Sharp); Nicaragua (Smith); Cuba (v. Martens); Hayti (Kingsley); Jamaica (Newport); Dominica (Pocock); Martinique (Sharp); Tobago (Mus. Strassburg¹⁸). — Cape Verde Islands: San Nicolao (Newport); San Jago (Bate).

7. *Atya gabonensis* Giebel, 1875.

Atya gabonensis Giebel, Zeitschr. f. d. gesammt. Naturwiss. (2), XI, 1875, p. 52.

Euatya sculptilis Kölbel, Sitz. Ber. Acad. Wiss. Wien, vol. 90, 1, 1884, p. 317, pl. 2, fig. 8, pl. 3.

Ayta sculptata Ortmann, Zoolog. Jahrb., V, 1890, p. 465.

Geographical distribution: Gaboon (Giebel); Orinoco (Kölbel).

8. *Atya* (*Evatya*) *crassa* Smith, 1871.

Smith, 2 and 3 Rep. Peabody Acad. Sci., 1871, p. 95.

Kölbel, Sitzb. Acad. Wiss., Wien, vol. 90, 1, 1884, p. 318, foot-note.

Geographical distribution: Nicaragua (Smith); Mexico: Presidio (Kölbel).

DOUBTFUL SPECIES.

Atya poeyi Guérin, Crust. in Ramon de la Sagra, Hist. de l'île de Cuba, 1857, p. 46, pl. 2, fig. 7. — Cuba.

Caridina mexicana Saussure, Mem. Soc. Phys. Hist. Nat. Genève, 14, 2, 1858, p. 463, pl. 4, fig. 26. — Mexico.

Atyoida glabra Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1878, p. 93. — Nicaragua.

Atya serrata Bate, Challenger Macrur., 1888, p. 699, pl. 119, fig. 2. — Cape Verde Isl.: San Jago.

These species may be the young of *A. scabra* or may belong to *Atyoida*.

Considerations concerning the geographical distribution of the Atyidae.

Some species of *Atyidae* were formerly considered to be marine animals; there is now no doubt that this family contains only fresh-water forms. This family is probably one of the most primitive groups of Decapoda living in fresh-water, having immigrated at an early geological period.

Only two species, *Caridina wycki* and *gracilirostris*, are recorded by Weber¹⁹ as found in a few cases in brackish waters of Sumatra

¹⁸ This locality is not yet published: there is one adult male from Tobago in the museum at Strassburg.

¹⁹ Die Süßwassererustaceen der Indischen Archipels. — Zoolog. Ergebn. Reise Niederl. Ost.-Indien., II, 1892, p. 542.

and Celebes.²⁰ I believe, that this occurrence may be considered as a re-adaptation of these two species, as they are found also in fresh-water. Since the genus *Caridina* is not a primitive one, while the genera of the *Xiphocarinae* are so, and live exclusively in fresh-water, it is very probable, that the fresh-water habit of the family must be regarded as the original manner of living. I believe, therefore, that the *Atyidae*, even of the Indian Archipelago, are not immigrants from the sea, as stated by Weber (l. c., p. 543), but "true localized fresh-water animals, forming an old element of the fresh-water fauna."²¹

The main differences of the *Atyidae* and their supposed ancestors, the *Acantheephyridae*, are morphological as well as biological, the *Acantheephyridae* being true marine, and essentially abyssal animals. To all appearance the morphological differences are causally connected with the change of habits. The peculiar pencil of hairs at the distal extremities of the fingers is adapted for securing the special food required, as described by F. Müller in *Atyoida potimirim*.²² No doubt the other species of *Atyidae* feed in the same manner. I cannot say whether the absence of the synhipod of the mandible is due to the same cause, since the function of the synhipod is unknown, but it may be in connection with it. On the other hand the habits of the *Acantheephyridae* are wholly unknown, so that we cannot compare this family with the *Atyidae*, but it is very probable that the morphological differences of the *Acantheephyridae* correspond to differences in the habits, especially in securing food.

We can state, briefly, that the *Atyidae* are closely allied to the most primitive *Eucyphidea*, forming a peculiar branch of development very early separated from the main stem, now represented by the *Acantheephyridae*. Their several characters are connected with a change of habit, and with the immigration to fresh-waters.

The geographical range of the *Atyidae* embraces the whole of the circumtropical parts of the world, members of the family being recorded from all the localities explored within these limits. Only in two localities does the range exceed the true tropics: in Japan, where it extends as far north as Tokio, and in the Mediterranean province,

²⁰ See de Man, *ibid.*, pp. 387, 399, 400.

²¹ Weber, l. c., p. 533: "echte regionale und locale Süßwassertiere, die einen alten Bestand der Süßwasser Fauna bilden."

²² Kosmos, IX, 1881, p. 117 ff.

where it extends northward to southern France and southern Austria. This nearly exclusive distribution within the tropics, at least in the warmer climates, shows that the family was probably also in former times an inhabitant of the warmer parts of the world, and the possibility is granted that the immigration into fresh-water took place at a time when climatic zones were not at all differentiated, a tropical climate prevailing everywhere. If this immigration took place in a later time, the poles having undergone a cooling, one could not understand the presence of the family in all parts of the tropics, as well as the occurrence of some genera (*Xiphocaris*, *Caridina*, *Atya*) on both of the present great continents, the eastern and western.

After the cooling of the northern and southern circumpolar regions²³ the range of the family was divided into two parts: an eastern comprising the tropical Africa, Asia, Australia, and the Pacific islands, and a western comprising tropical America.²⁴ The most primitive genera of the family were restricted in range by the concurrence of the more extremely developed ones, and the latter preserved a more circumtropical distribution.

It is very interesting to examine the geographical range of the genera and species from the point of view here given.

The most primitive genus, *Xiphocaris*, shows a distribution the peculiarity of which can only be understood by supposing that the range of this genus was formerly a more extended one, but that in most parts of the world the representatives were exterminated. Only three species survived, one of which lives now in the fresh-waters of the West Indies, the other in Indo-Malaysia, from Japan to Australia, and the third in New Zealand. From the intermediate countries species of this genus are not recorded. The Indo-Malaysian species, *Xiphocaris compressa*, repeats, as we know at present, this peculiarity in a reduced manner, being only recorded from Japan, the island of

²³ See Ortmann Jenaische Denkschr., VIII, 1894, p. 74, and Pfeffer, Versuch über die erdgeschichtliche Entwicklung der jetzigen Verbreitungsverhältnisse unseres Thierwelt. Hamburg, 1891.

²⁴ In case the *Atyidae* immigrated from the sea into the fresh-water after this separation, it is very probable that the geographical distribution would not be a circumtropical one, but that different groups immigrated into the western and eastern continents. We know another group of Decapoda, in which the latter is the case: the family *Telphusidae*, one subfamily of which the *Telphusinae*, being restricted to the tropical and subtropical parts of the eastern continents (Mediterranean, African, Indian, Indo-Malaysian, etc.), two other subfamilies, *Trichodactylinae* and *Pseudotelphusinae*, being restricted to the tropical parts of America.

Adenare, and from Queensland.²⁵ The closely allied genus *Troglocaris*, the only species of which might be regarded as a fourth form of *Xiphocaris*, lives in the subterranean waters of Carniola, a perfectly isolated locality in no way connected with the others named. The third primitive genus, *Atyaephyra*, is found near the locality of *Troglocaris* on the northern borders of the Mediterranean Sea. It is somewhat less primitive. The scattered localities at which are found the species of these three genera forming the subfamily *Xiphocarinae* are no doubt the remains of a more universal distribution in former times: the species now living show the character of true survivals.

In the subfamily *Atyinae*, the genus *Atyoida* shows a survival character similar to that of the *Xiphocarinae*; being recorded from the Sandwich Islands, Tahiti, and southern Brazil. But this genus must be the subject of farther study.

The genus *Caridina* appears to be nearly a circumtropical one. Its range is divided into two very unequal parts: the one comprising the West Indies and containing only one species, the other comprising a continuous area of the old world and containing at least nineteen other species. This area extends from South Africa along the east coast to the southern borders of the Mediterranean Sea and to Persia, crossing the islands of the Indian Ocean and Indo-Malaysia to Japan and Australia.²⁶ Species of this genus have not yet been found in West Africa, in southern Asia (except Ceylon and Siam), and in the Pacific islands, but it may be that some species will be discovered later in these countries.

This distribution of the genus can only be understood by supposing that it was present before a separation of the eastern and western parts of the tropics took place, and that the extended range of former times is now restricted to the tropical parts of the continents bordering the Indian Ocean and to its islands, and to the islands of eastern Asia from Japan to Australia. The occurrence of one species in the Nile and in the rivers of Algiers is due, I believe, to a more recent immigration from the central and eastern parts of Africa, not unlike the occurrence of *Palaemon nitolicus*.²⁷

²⁵ It may be that this species will be found on other islands between Asia and Australia, but it is very remarkable that the large collections of freshwater Crustacea made by M. Weber in the Indian Archipelago, and described by de Man, do not contain this species.

²⁶ A poorly described species is recorded from the Cape Verde Islands.

²⁷ See Ortmann, Zoolog. Jahrb., V, 1891, p. 745.

It is very probable that farther investigations will prove that the range of *Caridina* is a somewhat different one, since fresh-water crustacea of smaller size are mostly neglected by collectors, and the fauna of the fresh-waters of most tropical countries are very little known. Accordingly, the view given above on the geographical distribution of *Caridina* may, perhaps, have to be changed later.

The distribution of the most extreme genus of the family, *Atya*, is somewhat similar to that of *Caridina*. It is found, like the latter, in the West Indies and Indo-Malaysia, but there are some modifications. One species is known from West Africa, which is identical with another described from the Orinoco, and there is recorded one species from the Cape Verde Island, identical with the common West Indian form. The presence of identical fresh-water species, both in the West Indies and in West Africa, is a very remarkable fact, but not an isolated one among the Decapoda. We know another group of fresh-water Crustacea which shows the same peculiarity. Of the genus *Palæmon* there are three species described from West Africa, two of which, *Pal. jamaicensis* (= *vollenhoveni*) and *Pal. olfersi*, are likewise present in the West Indies, and one, *Pal. macrobrachion*, is closely allied to a West Indian species, *Pal. acanthurus*.²⁸ In *Atya* the identity of species of both continents bordering the Atlantic is due, no doubt, to other reasons than in *Palæmon*, the latter being a very recent genus, having immigrated to the fresh-waters quite recently, while some species are now immigrating from the sea to brackish and fresh-water. On the contrary, the immigration to fresh-water of the ancestors of *Atya* took place a long time ago, and, I think, this fact indicates a former connection of Africa and America.

The other range of the genus *Atya* extends over the islands of the Pacific from Sumatra to the Samoan islands. None is recorded from southern Asia, from the islands of the Indian Ocean, or from East Africa.²⁹

The two species described by A. Milne-Edwards from New Caledonia, *A. margaritacea* and *robusta*, are very doubtful, as I have stated above. I do not know another example of a fresh-water

²⁸ See Ortmann, *ibid.*, p. 747.—*Palæmon vollenhoveni* is certainly the same as *Pal. jamaicensis*; in the paper quoted I supposed them to be nearly allied, but distinct species.

²⁹ Only Hilgendorf (v. d. Decken's *Reisen*, III, 1, 1869, p. 101) records a very doubtful species from the Seychelles, belonging, perhaps, to *Atyoida*.

Decapod restricted to New Caledonia. Our present knowledge of the fresh-water fauna of the Pacific islands leaves it very improbable that New Caledonia has an isolated fauna, differing from that of the other islands. It is probable, on the contrary, that species found in New Caledonia will be found also in other islands, but since A. Milne-Edwards, in 1864, described these two species, they have never been recorded from any place in the Pacific. It may be added that the differences of these species from the West Indian, *A. scabra*, given by A. Milne-Edwards, are scarcely at all present. I am, therefore, induced to suppose that both are erroneously recorded from New Caledonia, the true locality being the West Indies, and that they are identical with *A. scabra*.

If these considerations are correct, the genus *Atya* can be divided into two groups: the one containing the species bearing on each side of the rostrum at the base a spiniform angle, the other containing the species without a spiniform angle. To the first belong the species *A. scabra*, *gabonensis*, and *crassa*, their range extending over tropical America and West Africa; to the second belong *A. moluccensis*, *spinipes*, and *brevirostris*, the range of which comprises the Indo-Malaysian and Pacific islands. The last named species, *brevirostris*, forms a transition from the second group to the first. Then the range of the genus *Atya* would be divided into two parts, each containing a separate group of the genus, and this peculiarity could be explained by supposing that these two groups may be developed separately from each other after the separation of the former connecting range of the genus. This conjecture agrees with the fact, that *Atya* is the most extreme genus of *Atyidæ*, and with its supposed recent age.

We know that some fresh-water animals are rapidly distributed over great distances, either in the adult or in the larval state, but in the *Atyidæ* we know nothing of the means of distribution.

Comparing the other Crustacean Decapoda we may say, that the *Atyidæ* have not been transported to great distances. Nor is it probable that the eggs can endure a long time without water, or that the larvæ or the adult animals can leave the water for any length of time. Transportation of the species of *Atyidæ*, in either the active or passive state, from one fresh-water system to another over the land or through the air, cannot be supposed, at least over great distances. Neither can the *Atyidæ* live in the sea, so that the

most important *topographical barriers* to distribution would be widely extending oceans and large tracts of land without fresh-water. The Pacific Ocean forms a barrier of the first kind, while the second may be partly connected with the *climatic conditions* of the warmer parts of the world. Smaller areas of sea and land, however, may be crossed by some forms, as is shown especially in the distribution of some species of *Caridina* and *Atya*³⁰. The means of distribution are certainly very limited, and therefore a great number of species are confined to very narrow districts.

Lastly, the ancient character of the family induces me to suppose that there are also *bionomic barriers*, the *Atyidæ* not being able to immigrate to localities occupied by other fresh-water animals better equipped for the struggle for existence.

I regret very much that exact observations on the habits of the species of *Atyidæ*, on the biology and bionomy, are wholly absent. It is very probable that the different genera and species on farther examination will show some differences, especially that the best developed are more resistant to external influences.

The conditions of geographical distribution of the *Atyidæ* are as follows:—

1. The *Atyidæ* cannot endure cooler climates. (*Climatic barriers*.)
2. They are true fresh-water animals. (Oceans and tracts of land without water form *topographic barriers*.)
3. Being animals of an ancient type, they are probably restricted by the occurrence of other fresh-water animals. (*Bionomic barriers*.)
4. The faculties of distribution are very limited.

The *Atyidæ* are, therefore, confined to the fresh-waters of the tropics and subtropics; the distribution of the genera and species, especially of the more primitive ones, shows a remarkable character of survival. Only *Caridina* and *Atya* are of a more recent character, extending over continuous areas within the tropics. Because of the antiquity of the family it has no relations among the recent forms of the litoral regions of the tropical seas.³¹

³⁰ *Caridina typus, wycki, nilotica*; *Atya scabra, moluccensis, spinipes*.

³¹ Such relations to the *Atlantic, Indo-Pacific, and Western-American* regions (see Ortmann, *Jenaische Denkschr.*, VIII, 1894, p. 76) are not at all evident, none of the well-known genera or species being limited by the borders of one of these regions.

NOVEMBER 6.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Forty-one persons present.

A paper entitled "The Batrachia and Reptilia of the University of Pennsylvania West Indian Exploration of 1891," by Edw. D. Cope, was presented for publication.

NOVEMBER 13.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Thirty-nine persons present.

Papers under the following titles were presented for publication:—

"The Structure and Relationships of Ancodus," by W. B. Scott.

"A Supplementary Note to Mr. Johnson's List of Jamaica Diptera," by T. D. A. Cockerell.

NOVEMBER 20.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Ninety-five persons present.

The deaths of the following members were announced:—

Robert E. Peterson, Archibald McIntyre, Samuel Jeanes and Joseph Jeanes.

A paper entitled "A New Jumping Mouse from the Pacific Slope," by Samuel N. Rhoads, was presented for publication.

DR. JOHN MACFARLANE read a communication on the Movements of Plants under Plates of Colored Glass. (No abstract.)

NOVEMBER 27.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Fifty-eight persons present.

Papers under the following titles were presented for publication:—

"The Osteology of Hyænodon," by William B. Scott.

"A New Insectivore from the White River Beds," by William B. Scott.