

II.—NOTES ON MAJOR WALTON'S SPECIMENS AND ON OTHERS FROM KASHMIR WITH A LIST OF PREVIOUS RECORDS FROM EASTERN ASIA.

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In addition to the fine specimens of *Apus* sent to us by Major Walton a number have been obtained during the present year from Kashmir. For these we are indebted to Mr. T. Bainbrigge Fletcher of the Agricultural Research Institute, Pusa, who received them from the Settlement Commissioner of Jammu and Kashmir State.

When forwarding the specimens the Commissioner remarks that they "occasionally do much damage to rice seedlings in the Banihal ilaka south of the Pir Panjal range at a height of about 6,000 ft. The damage occurs in the first few days of growth only, mainly where the irrigation water is particularly cold, and is greater in a year like the present, when the winter snow-fall is exceptionally heavy and melts late." He also remarks that as far as he is aware it does not occur in the extensive rice cultivation of the Kashmir valley, a region separated from the Banihal district by the Pir Panjal range, in this part from 9,200 to 14,000 ft. in height; nor does it seem to occur in the lower hills to the south.

While the re-discovery of this genus in India in two widely separated localities after a lapse of forty years is of considerable interest, it coincides with our knowledge of its erratic occurrence in other countries. But the statement that *Apus* has become an agricultural pest in Kashmir calls for further investigation.

No males occur in either collection.

I have carefully examined Major Walton's specimens and also those from Kashmir and have reached the conclusion that all are specifically identical with the European *A. cancriformis*. It must however be confessed that this determination is made with no great confidence; the taxonomy of the Notostraca stands in urgent need of revision and a study of the literature seems to indicate that the characters used for specific differentiation are few in number and for the most part subject to much variation. There can be little doubt that when the group is monographed a considerable reduction in the numbers of known species will be effected.

There are, indeed, noticeable distinctions between the specimens from Kashmir and those from Bulandshahr; but it appears probable that these are due merely to differences in biological conditions correlated with altitude and, until the importance of

this factor has been ascertained, it seems best to refrain from further additions to the nomenclature.

The Bulandshahr specimens range from 30 to 40 mm. in length excluding the furcal rami and according to Major Walton the average length of all obtained is 33 mm. In a perfect individual 30 mm. in length, the length of the shield in the middle line is 22 mm., that of the median carina 16 mm. and that of the furcal rami 29 mm.¹ The long ramus or fifth endite of the first trunk-limbs reaches well beyond the posterior extremity of the shield; it measures 22.5 mm. in length and is composed of about 58 segments.

On comparison the appendages were found to agree very closely with those of specimens of *A. cancriformis* from Lombardy and with those figured by Lankester² from examples obtained at Munich, Prag and Padua. The segments of the first trunk-limbs, while distinctly longer than is indicated in Lankester's figure, are similar to those of the Italian specimens. As regards the number of these segments there again appears to be considerable variation. Lankester gives the number as 80, but Packard³ states there are only 50 and points to the greater number (80) found in *A. himalayanus* as an important feature of that species. In the Bulandshahr specimens, as mentioned above, the number does not seem to exceed 60 and in this respect direct comparison with the Italian examples in the Museum collection is unfortunately impossible, for in them these appendages are all broken.

In the specific determination of Apodidae great significance has been attributed to the length of the body as shown by the number of segments uncovered dorsally behind the median notch of the carapace and ventrally behind the last pair of trunk-appendages. Perhaps too much stress has been laid on the former character, for, while it is true that in certain cases it affords a very obvious distinction between species, it seems that it is to some extent dependant on the amount of shrinkage that has taken place during preservation, and a glance at Wolf's figures of *Lepidurus viridis*, vars. *clongatus* and *setosus*,⁴ yields convincing proof of the great variation of this character within the limits of a single species. In the Bulandshahr specimens from 8—11 segments are exposed in dorsal view.

The number of segments seen from below behind the last pair of trunk-limbs appears to constitute a more valuable feature; five such segments are found in Major Walton's specimens and five also occur in the Italian examples of *A. cancriformis*. According to Packard (*loc. cit.*) there are six in this species, while Braem⁵ found that in females from the neighbourhood of Breslau the number varied from five to seven.

¹ See also the other measurements given by Walton, *ante*, p. 352.

² *Q. J. Micr. Sci.* (n. s.), xxi, p. 343, pl. xx (1881).

³ *Ann. Mag. Nat. Hist.* (4), viii, p. 335 (1871).

⁴ Wolf, *Fauna Südwest Australiens*, iii, lf. 9, pp. 267—9, text-figs. 11, 13 (1911).

⁵ Braem, *Zeitschr. Wiss. Zool.*, lvi, p. 183 (1893).

The average diameter of the eggs is .49 mm.

The Kashmir specimens appear to differ from those found at Bulandshahr only in two respects:—

- (1) The size is much smaller, the average length of the body in 20 specimens is 20.6 mm. (excluding the furcal rami), the extremes being 15 and 25 mm.
- (2) The surface of the carapace, when the moisture has been removed, is seen to be covered with fine and short irregular ridges, giving it a wrinkled and reticulate appearance which is specially well-marked in the neighbourhood of the shell-gland.

In addition the spines on the posterior margin of the carapace appear relatively a trifle larger than in the examples from the United Provinces.

Twenty specimens yield the following measurements (in mm.):—

	Maximum.	Minimum.	Average.
Total length excluding furcal rami ..	25	15	20.6
Length of carapace in median line ..	18	12	15.2
Length of median carina of carapace	12.5	8	10.4

The furcal ramus, when unbroken, is as long as, or a trifle longer than, the total body-length and the fifth endite of the first thoracic limbs reaches beyond the posterior margin of the carapace and is composed of about 55—60 segments. Dorsally from 10 to 15 abdominal somites are exposed behind the carapace and ventrally there are 5 or 6 (the latter rather more often than the former) behind the last pair of appendages. The average diameter of the eggs is .47 mm.

As regards colour, the specimens are of a dull olivaceous green obscurely mottled with a darker shade.

In their large size and smooth carapace the specimens from the United Provinces agree with the Italian examples of *A. cancri-formis*; but Lilljeborg¹ in his description of large individuals of this species from Sweden remarks "Scutum ad latera supra folliculos testae plures carinas obliquas humiliores et breviores praebens" a statement which seems to accord well enough with the Kashmir specimens.

As has already been noted, the possibility that the characters of the species are deeply influenced by external conditions is great,

¹ *Synopsis Crust. Suecicorum Branchiopodorum et Phyllopororum*, p. 8 (1877).

and, until further evidence on this point is forthcoming, the Kashmir and Bulandshahr specimens are best regarded as local races, or perhaps merely phases, of *A. cancriformis*. The descriptions of this species which I have been able to consult contain many discrepancies and it may well be that distinct races exist in different parts of Europe and Asia.

Cavalier¹ has recently published a brief note on the occurrence of *A. cancriformis* at a height of 10,000 ft. on the Bingöl Dag in Armenia and remarks that "as Crustacea at such heights are rarely discovered I think it worthy of record that these are practically identical with the common European species, though this is only in accordance with the results of Grube on *Apus* from L. Baikal and of Gerstaecker on the Siberian *Branchipus*; but there are some slight differences in the appendages." Grube's paper is cited as *Jahres-Bericht schl. Gesell.*, 1872, p. 53, and although this does indeed refer to an account by that author of the L. Baikal fauna, I have been unable to find therein any mention of *Apus*; nor in any other work which I have examined have I found Cavalier's citation repeated.

Previous records of *Apus* from Eastern Asia do not appear to be numerous; the following list contains all that I have been able to discover:—

Apus himalayanus, Packard, *Ann. Mag. Nat. Hist.* (4), viii, 1871, p. 334.

I have only been able to consult Packard's preliminary account of this species. It is stated to be closely allied to *A. cancriformis* and the distinctions noted do not suffice to separate it from that species: the range of variation in the European form, as judged by a comparison of several descriptions, appears to cover all the differential features mentioned by Packard.² Considered in the light of this paper only, the specimens from Kashmir and Bulandshahr agree with *A. cancriformis* rather than *A. himalayanus*.

Packard records two specimens "collected from a stagnant pool in a jungle four days after a shower of rain had fallen. For five months previous to this rain there had been no rain upon the earth. Himalaya Mountains, North India, near where the Sutlege river debouches into the plains—April, 1870."

Apus dukianus, Day, *Proc. Zool. Soc. London*, 1880, p. 392 (text-fig.).

The specimens from which this species was described were found in April, 1877, in a pond near Kelat in Afghanistan. The great length of the body, coupled with the

¹ *Ann. Mag. Nat. Hist.* (7), viii, p. 160 (1901).

² Some error seems to have crept into the measurements which Packard gives, for the length of the carina of the carapace plus the pre-carinal length is far greater than the total length of the shield.

shortness of the furcal rami readily distinguish it from *A. cancriformis* and *A. himalayanus* and there does not seem any probability in Lankester's suggestion¹ that it is synonymous with the latter species.

The specimens which Vredenburg found at Thalonk in Kharan State, Western Baluchistan,² belong, as far as can be judged, to the same species as that described by Day: Vredenburg's rough sketch is at any rate sufficient to show their close affinity with that form.

The possible identity of *A. dukianus* with one of the long-bodied forms described from other countries must not be over-looked; but this point cannot be decided until the group is subjected to revision.

Apus sudanicus var. *chinensis*, Braem, *Zeitschr. Wiss. Zool.*, lvi, 1893, p. 180.

The variety *chinensis* was described by Braem from eight specimens found in the Breslau Museum labelled *Apus*, China.³ *A. sudanicus*, the typical form, was described by Brauer³ from specimens taken at Khartoum in the Soudan.

Apus granarius, *vide* Gerstaecker, Bronn's *Thierreich*, v, 1866-79, p. 1063.

Gerstaecker in a distribution table of the Branchiopoda notes the occurrence of this species at Pekin. I have not been able to find the original description or any other record of the species. Major Walton has also recorded a species of this genus or of *Lepidurus* at Pekin (*ante*, p. 351).

Apus sp., Schlagintweit, *Rcisen in Indien und Hochasien*, iii, 1872, p. 217 (Jena).

A brief notice of the occurrence of a species in the Salt Lakes of Tibet. The lakes were partially dry on the occasion of Schlagintweit's visit; dead specimens were found round the margins, but a few examples were discovered alive under stones in water of considerable salinity.

¹ *Loc. cit.*, p. 344 (footnote).

² *Journ. A. S. B.* (n. s.), i, p. 33 (1906).

³ *Sitz. Kais. Akad. Wiss. Wien*, lxxv, abth. i, p. 590 (1877).