ON A NEW GENUS OF PHREATOICID ISOPOD FROM WELLS IN BANARAS.

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(Plates XVII—XX.)

INTRODUCTION.

Material.—Some time in 1946, Dr. M. Sharif of the Haffkine Institute of Preventive Medicine, Bombay, sent to the Zoological Survey of India for identification some specimens of an Isopod that had been collected in a *pucca* well at Lohagara Railway Station, eighteen miles from Allahabad. Though a cursory examination showed them to be unusual in several respects, the specimens were kept aside for subsequent detailed study on account of more pressing work. A little later, Dr. A. K. Mitra of the Department of Anthropology brought to the Survey a living Isopod that he had found in a pail of water drawn from a well near his residence in Banaras. This Isopod also showed the same unusual characters that had been observed earlier in the specimens from the Allahabad District. This specimen was kept alive in a jar of well water for studying its habits, etc., and, simultaneously, attempts were made to collect more material from the same and other wells in Banaras. The specimen continued to live for nearly two months, and apart from changing occasionally the water in which it was kept, it required no other attention in the way of additional food, etc. A considerable number of specimens was later collected from several wells in Banaras.

A careful examination of the material showed that the animals belong to the Isopodan sub-order Phreatoicoidea. This sub-order is known to have a very interesting distribution, being somewhat plentiful in Australia, Tasmania and New Zealand and having been found outside this region only in the Cape Province of South Africa. Its occurrence in South Asia was, therefore, considered to be of particular significance, and the find was reported by one of us (Chopra, 1947, p. 176) early in 1947. The work had so far been carried out by the first author only but as he was transferred from the Zoological Survey of India soon after this, he handed over his notes, illustrations, etc., to the second author, who continued the investigation from the point at which it had been left. Though the two authors have been in constant touch with each other throughout the progress of the investigation, the major part of the work such as drawing up of the descriptions and preparing the manuscript of the paper, etc., has been done by the second author.

Locality and Ecology.—Banaras, from where the major part of the material on which the paper is based was obtained, is in the Eastern part of the State of Uttar Pradesh, in 25° 18′ north latitude and 83° 1′ east longitude. " The whole district of Benares forms part of the Gangetic plain and its geology exposes nothing beyond the ordinary alluvium. The northernmost outliers of the Vindhyan Hills are in Mirzapur to the South and rock never appears in Benares. The depth of alluvium has never been proved but sections obtained by sinking wells generally give some 35′ of loam, or clay mixed with sand in varying proportions, 30′ of blue silt, 20′ of strong clay and below that a water bearing stratum of reddish sand " (Nevill, 1909, p. 2).

Banaras stands on the left bank of the Ganges and though a part of the water supply of the town comes from the river, there are numerous wells all over the town, mainly for drinking purposes. The wells are generally three to five feet in diameter and the water level is about 20′ to 40′ below the surface. The depth of water in the wells varies from 30′ to 60′ The wells are always lined with brick and many are plastered with lime or cement. The mouth of wells is always raised above the surface and is surrounded by a masonary platform. Many wells have their mouths partially covered with wooden planking. Because of the small opening and the low level of water, very little direct sunlight reaches the surface of water.

Besides these Isopods, one species of *Cyclops* is very common in most of these wells.

General Observations on Systematics.—The sub-order Phreatoicoidea is believed to be of ancient origin and is supposed to have established itself in the early Mesozoic period. The occurrence of living representatives of this sub-order in the Australian region at one end and through India to South Africa at the other, further supports the geological hypothesis of the existence of the Gondwanaland during the Mesozoic era.

Nicholls (1943*a* and 1943*b*) has published two excellent memoirs on the Phreatoicoidea which contain a detailed account of all the known members of this group, together with their affinities, distribution, etc. A careful comparison of our material with the numerous forms described by Nicholls has shown that the Indian specimens cannot be referred to any of the known genera of this group and we have, therefore, been obliged to create a new genus for it. A new sub-family has also been established to accommodate the Indian genus, as it cannot be referred to any of the so far known sub-families.

Acknowledgments.—We are greatly indebted to Professor G. E. Nicholls not only for kindly examining some of our specimens and verifying our identification, but also for numerous helpful suggestions. Our thanks are also due to Drs. M. Sharif and A. K. Mitra for bringing their interesting finds to our notice and to Dr. B. S. Chauhan of the Zoological Survey of India for helping the second author in the course of this work.

SYSTEMATIC ACCOUNT.

Family AMPHISOPIDAE.

Sub-family *NICHOLLSINAE.*

Body long, vermiform and smooth. Head with an incomplete cervical groove; eyes absent. First peraeon segment short, ventrally expanded and free from head. Pleura of the pleon segments not greatly produced downwards. Tail-piece long; telson emarginate, its lateral free edges crenulate. Antennule long, filiform. Gnathopods similar in both sexes; bases of peraeopods not appreciably expanded; fourth peraeopod not sexually modified in male. Oostegites on first four pairs of peraeopods of female. Posterior pleopods sub-equal to anterior series; coupling hooks absent; few entangling setae on sympodites; exopod smooth, bilobed (except in first pair), the lobe displaced more laterally; endopod reduced, smooth, cleft longitudinally up to the middle; penial stylet short, curved, with a complex musculature. Outer ramus of uropod longer than the inner, and much longer than the tail-piece in males.

The sub-family Nichollsinae is related to the Mesamphisopinae (Nicholls, 1943*a*, p. 29) on account of the short first peraeon segment free from head, and to the Hypsimetopinae (Nicholls, 1943*a*, p. 120) on account of the absence of coupling hooks on the sympodite of pleopods.

Genus **Nichollsia**[1], nov.

Body slender, smooth and vermiform, maintaining a uniform width throughout; length 14 to 16 times its width in adult specimens. Head short, longer than wide, and as wide as deep; fronto-lateral projections prominent, sub-ocular incisure deep, mandibles forwardly placed, posterior process wanting; post-mandibular portion of the head almost equal to the mandibular portion; cervical groove incomplete; eyes wanting. Peraeon wider than deep; first segment short, free from the head and expanded ventro-laterally; pleura of peraeon segments obsolete, exposing the ventral parts; sterna of the peraeon segments keeled. Pleon rather long, deeper than peraeon, with pleura very slightly projecting downwards; tail-piece long, as wide and deep as pleon; suture between the sixth pleon segment and telson wanting; apex of telson emarginate dorsally, its descending lateral edges crenulate.

Antennule long, filiform; both mandibles with lacinia mobilis. Gnathopods normal and similar in both sexes; bases of peraeopods very slightly expanded; fourth peraeopod not modified in male. Posterior pleopods not much reduced, endopod clefted in the middle; penial stylet short, stout, curved and with a complex musculature. Peduncle of uropod mesially ridged, produced into three blunt tubercles at the disto-lateral angle; outer ramus lamellar, much longer than the inner, and in adult males longer than the tail-piece.

Four pairs of oostegites in female.

[1] Named after Prof. G. E. Nicholls, lately Professor of Zoology, University of Western Australia.

Genotype.—Nichollsia kashiense, sp. nov.

The genus *Nichollsia* shows some similarities with *Phreatoicoides* Sayce (1900, p. 122), *Hypsimetopus* Sayce (1902, p. 219) and *Hyperoedesipus* Nicholls and Milner (1923, p. 23). This question is discussed in some detail in a subsequent part of the paper.

Nichollsia kashiense, sp. nov.

(Plates XVII—XX.)

Body (Pl. XVII, figs. 2 and 3).—The body is long, slender and vermi form. Width is uniform throughout. Length of body measures 14 to 16 times in width in adult specimens preserved in spirit. Except for a few short and stiff hairs, the body is smooth and devoid of any sculpturing.

Head (Pl. XVII, fig. 1).—Head is rather short. It is subequal to the second peraeon segment and shorter than the third and fourth. It is somewhat shallow, being longer than deep. Width and depth are equal. Its dorsal surface is faintly convex. Seen in dorsal view (Pl. XVII, fig. 3) it is roughly rectangular in shape. The antero-dorsal margin of the head is strongly convex, the front sloping steeply forwards. Fronto-lateral corner (Pl. XVII, fig. 1, fr. p.) is produced into a large angular projection on each side. The sub-ocular incisure is deep. Antero-ventral corner of the head is bluntly angular, and behind this the sub-orbital notch (fig. 1, *sub. orb.*) is conspicuous. A shallow genal groove begins from the hinder angle of the sub-ocular incisure and ends in the sub-orbital notch. Behind the sub-orbital notch, the ventral edge of the head forms an oblique, sloping line with the mandible (Pl. XVII, fig. 2,). Posterior process is wanting and post-mandibular portion of the ventral margin of head is horizontal, and equal to mandibular region. Postero-dorsal margin of head is convex, the sides descending obliquely forwards up to the middle, from where they descend vertically to meet the ventral border. This vertical lower half of the postero-lateral edge is slightly overlapped by antero-ventral expansion of the first peraeon segment. Cervical groove (Pl. XVII, fig. 1, *c.gr.*) is conspicuous only on sides. In younger examples, and in some adults also, a faint groove, parallel to the ventral edge of head is present, and it meets the ascending arm of the cervical groove. Eyes are absent. The ocular area (which is very prominent in fresh specimens) is seen as a shallow triangular depression in specimens preserved in spirit for a long time.

Peraeon (Pl. XVII, figs. 2 and 3).—Peraeon is long with uniform width and depth. It is wider than deep. The *first* segment (fig. 1, *per.* 1.) is very short in mid-dorsal line, measuring from one-third to one-fifth of the dorsal length of head. The antero-dorsal margin is strongly concave, the corresponding posterior margin being straight. The antero-ventral border of this segment is expanded and overlaps the lower half of the hinder margin of the head. Segments *two* to *four* show a progressive increase in length, the *fourth* being the longest; posterior to *fourth* the remaining segments progressively decrease in length. Each segment

is longer than wide, and wider than deep. The ratio of length to breadth is maximum in the *fourth* segment, but less in the segments in front, or behind it. The antero-ventral corners of *second* to *fourth* segments are produced in front of their respective coxal attachments. Postero-ventral corners are rounded. In the posterior series of *fifth* to *seventh* segments both antero- and postero-ventral corners are rounded and ventral edges are slightly emarginate in the region where the legs are attached. The sterna of *all* segments are compressed, and produced posteriorly, this compression being more conspicuous in the posterior segments.

Pleon (Pl. XVII, figs. 2 and 3).—Pleon, when compared with that of the other subterranean genera of the family Amphisopidae, is rather long. If the length of cephaloperaeon is taken as 100, the length of pleon varies from 63 to 82, and compared with the total length of body, this ratio is as 100 : 40-45. The great increase in length of the pleon is partly due to elongation of tail-piece (Pl. XVII, figs. 2 and 3, *t.p.*), which is more than half as long as the rest of pleon segments taken together. The proportion of combined length of the pleon-telson to tail-piece is as 11 : 4. Pleon is as wide as peraeon, but deeper than it owing to a slight downward extension of the pleura, which, however, do not cover the sympodites of pleopods. First *four* pleon segments are short, sub-equal, and wider than long; the *fifth* is longer than the rest, but not longer than the combined length of any two. Depth of *first four* segments is distinctly greater than their length or width; the *fifth* is, however, somewhat longer than wide, and only slightly deeper than long. Free pleural margins of each segment are straight, posterior corners angular, and anterior ones blunt. Seen dorsally or laterally, the pleon segments are rectangular and except for scattered individual hairs, the pleon is smooth. The tail-piece (*sixth* pleon segment+telson) (Pl. XVII, fig. 2, *t.p.*) is one and a half-time as long as deep, and twice as long as wide. Its dorsal surface (fig. 3) is rounded and ventral surface (fig. 10) flat. The antero-lateral margin of tailpiece obliquely ascends upwards (Pl. XVII, figs. 2 & 4), attachment with the fifth pleon segment being in the upper half. Antero-ventral angle is rounded. Ventral margin is straight, and anteriorly it bears three backwardly directed spines. Telson is firmly united with sixth pleon segment. Telsonic apex (Pl. XVII, figs. 2, 3, 4, 5 and 11, *po.ma.* and *la.m.*) is strongly emarginate. Dorsally the telson (Pl. XVII, fig. 5, *po. ma.*) is of the shape of a shallow horse-shoe. Below the postero-dorsal corner, the free lateral edge (Pl. XVII, fig. 4, *la.m*) is turned downwards and backwards in an undulating curve, the upper half containing two rather widely-separated notches and the lower half being more compactly crenulated. As it reaches the region of uropodal peduncle (fig. 4, *u.p.*), this descending edge turns anteriorwards, running parallel to, and in contact with the peduncle, behind which it steeply turns down vertically to meet the ventral edge of tail-piece at right angles. The ventral surface of tail-piece (fig. 10) is flat with parallel sides, the anterior margin straight, and posterior margin produced mesially into an angle between uropodal peduncles. Anus (Pl. XVII, fig. 5, *an.*) is a vertical slit on the posterior face, above the insertion of peduncle of uropods.

Antennule (Pl. XVII, fig. 6).—Antennule is long and filiform, consisting of 16 joints. It exceeds the peduncle of antenna by four to six of its terminal joints. First three or four joints are longish, the distal joints become progressively short and narrow. Short scattered hairs are present on all joints.

The antennule of *N. kashiense* is longer than that in other subterranean genera. Nicholls (1943*a*, p. 6) believes this type of antennule to be more primitive than the short, club-shaped antennule found in a large number of Phreatoicids. A long, filiform antenule is characteristic of the Amphisopinae and Phreatomerinae among Amphisopids.

Antenna (Pl. XVII, fig. 7).—Antenna is moderately long, being somewhat less than half the length of body. The five-jointed peduncle is almost half as long as the flagellum. First three joints of the peduncle are short and sub-equal, fourth is longer and fifth is twice the length of the fourth. Flagellum consists of thirty joints. The basal joints are longer, and length of the joints progressively diminishes towards the distal extremity. A few stiff hairs are present on the peduncle and flagellum.

Labrum (Pl. XVII, fig. 8) is large and assymetrical and resembles that of *Mesamphisopus capensis* (Barnard, 1914, p. 223, and Nicholls, 1943*a*, p. 31).

Mandible (Pl. XVII, fig. 2, *mnd.*, and Pl. XVIII, figs. 1 & 2).—Both mandibles possess lacinia mobilis. They form an oblique sloping line with the ventral edge of head, behind the sub-orbital notch in which fits the fulcral process of mandible. The left mandible is somewhat larger than the right. The incisor (Pl. XVIII, fig. 1, *i.pr.*) of the left mandible bears four strongly chitinised teeth. Its lacinia mobilis (Pl. XVIII, fig. 1, *la.m.*) is tridentate and chitinised. Spine row (Pl. XVIII, fig. 1, *sp.*) is borne on a ridge sub-parallel to the lacinia mobilis and carries about half a dozen spines, pectinate on one side. This is followed by a row of plumed setae, about eight or nine in number, borne on a ridge between the base of spine row and molar process. Molar process (Pl. XVIII, fig. 1, *m.pr.*) is well developed; its anterior and lower margins are fringed with cilia, the lowermost five or six of which are long and setose. The shallow, convex shaft also appears to be ciliated. A fringe of cilia also borders the bend between the incisor and molar. Acetabular process (Pl. XVIII, fig. 1, *ace.*) is well developed. Fulcral process (Pl. XVIII, fig. 1, *f.pr.*) is conical and prominent. The palp (Pl. XVIII, fig. 2, *mnd.p.* and Pl, XVIII, figs. 1 and 2) is three-jointed—first joint is short, second nearly double the length of first, and third sub-equal to second and compressed Inner margin of the first joint is ciliated. The third joint is broadly triangular, its distal half on the inner side being concave. The apex of the third joint bears eight or nine, long, finely dentate setae; the inner concave margin carries a fringe of about two dozen shorter dentate setae. Other joints are beset with scattered stiff setae. In the right mandible, incisor is weakly chitinised, lacinia is non-chitinised and its teeth are finely serrate, and the fringe of cilia on the margin of mola shaft is longer. The spine row carries a smaller number of pectinate and plumed spines.

Maxillula (Pl. XVII, fig. 9).—Proximal endite (*pr.end.1*) is short, its apex broad and truncated. The apex carries a row of nine hairy spines of which the first and last are short. The distal endite (*dis.end.1*) is longer, and somewhat broader than the proximal. The apex bears about fifteen pectinate spines, disposed in transverse rows of three each in the proximal series and five or six in the distalmost. These spines are slightly chitinised. The distal half of the posterior edge of the proximal endite and that of the anterior edge of distal endite are fringed with cilia.

Maxilla (Pl. XVIII, fig. 3).—Maxilla shows typical amphisopid condition. The proximal endite (*pr.end.2*) is triangular, with a broad base and narrow, truncated apex. Its mesial edge (*mes.*) is almost straight, with no sharp demarcation between the basal and apical regions. The row of filtratory setae (*fil.se.*), about 36 in number, is well developed, but the setae do not appear to be ciliated. Submarginally, the posterior surface bears a row of about fifteen pectinate spines (*pct.*) which continue upto the apex, and behind this row of spines there is a row of dense cilia. Basally the posterior surface is fringed with small cilia. On the anterior side there are four or five setae in the submarginal concavity at the base. Apex of this endite bears about fifteen setose spines and its distal free margin is ciliated. The middle and outer lobes of the distal endite (*dis.end.2*) are broader and more elevated than the proximal endite. The apex is oblique anteriorly and bears dentate spines, which are about a dozen in number on the middle lobe and about a dozen and a half on the outer. Free margins of these lobes are ciliated. The outer lobe, behind the apical dentate spines, carries a few short and simple spines. The maxillae are similar on both sides and in both sexes.

Labium (Pl. XVIII, fig. 4) is large and bilobed. Apex of each lobe is densely ciliated on the inner side ; towards the base, the cilia are shorter and less dense.

Maxillipede (Pl. XVII, fig. 1, *mxp.* and Pl. XVIII, figs. 5 and 6).—Maxillipede does not show any marked departure from the usual Phreatoicine pattern. Coxa (*co.*) is short and its epipodite (*ep.*) is large, broadly elliptical and free from cilia and hairs. Basis (*ba.*) is twice as long as broad, fringed with a row of simple, short setae on its outer edge, and a single large plumed spine on the postero-distal corner. Endopodite (*end.*) arises in the middle of the basis. It is broad distally and extends up to the end of triangular merus. Its antero-mesial and distal edges are fringed with long, brush setae. A single large coupling hook (*co.h.*) is present in the usual position. Posterior edge is bare except for a few short, simple setae. Ischium (*is.*) is short. Merus (*me.*) is sub-triangular, with a short postero-distal projection bearing two simple setae. Carpus (*ca.*) and propodus (*pr.*) are elongate oval, fringed with a row of long simple setae on the anterior, and only a few setae on the posterior edge. Dactylus (*da.*) is short, narrow and elongate, with apex fringed with long setae.

Peraeopods (Pl.XIX, figs. 1 to 8).—Peraeopods resemble those of *Hyperoedesipus plumosus* Nicholls and Milner (1923, pp. 23-33, Pls. II-V and Nicholls, 1943*a*, pp. 49-57, figs. 12, 13) except that the ganthopod

and fourth peraeopod are not sexually modified in males. Coxae of all peraeopods are fused with the epimera of their respective segments; the first four pairs are attached on the anterior, and last three on the posterior end of the segments.

Gnathopod (Pl.XIX, figs. 1 and 2) is similar in both sexes, resembling that of the female of *Hyperoedesipus*. It is short and stout. Coxa is broad. Basis (*ba.*) is long and moderately expanded. Ischium (is.) is shorter than basis. Merus (*me.*) is sub-quadrangular, and its antero-distal angle is somewhat produced. Carpus (*ca.*) is short and triangular. Propodus (*pr.*) is about as long as the basis and moderately expanded. It is narrow basally; its anterior (dorsal) edge is convex and posterior (ventral) straight. Its posterior margin bears five or six spines, and a sub-marginal row of a few short hairs. The dactylus (*da.*) is shorter than the ventral margin of propodus and is usually flexed below the latter. Its inner edge, facing the propodus is straight, the outer edge being somewhat convex. Distally it tapers into a long, narrow, inwardly bent claw. The posterior edge (which faces the propodus when in flexed condition) is dentate, carrying about eight short, forwardly directed teeth and a sub-margical row of six setae. The free edges of all the joints of the gnathopod are beset with scattered spines, which are more numerous on the anterior margin of the dactylus and antero-distal angle of palm. The carpus bears four short spines and about half a dozen setae on its posterior edge.

Of the succeeding pairs of peraeopods, those of the anterior series of three (Pl. XIX, figs. 3, 4 and 5) are somewhat stouter than those of the posterior series (Pl. XIX, figs. 6, 7 and 8). In the second (fig. 3), third (fig. 4) and fourth (fig. 5) peraeopods bases are expanded a little and individual joints are somewhat compressed. Merus (*me.*) is slightly produced antero-distally. The posterior three pairs, fifth (fig. 6), sixth (fig. 7) and seventh (fig. 8) are slender and their individual joints are elongated, the antero-distal projection of merus being more obsolete. Dactylus in all peraeopods is very short and ends in a stout, curved claw which bears a short unguis at its base. The posterior border of propodus bears a row of spines, four or five in the anterior series, and seven or eight in the posterior. Edges of all legs are fringed with setae and spines, which are more numerous on the posterior edge of carpus, and antero-distal angle of merus.

Coxae of seventh peraeopods bear a pair of long penes (Pl. XVII, figs. 12 and 13, *pe.*).

Pleopods (Pl. XX, figs. 1, 2, 3, 4 and 5).—Pleopods are foliaceous and probably respiratory in function. Epipodites are absent, and the sympodites are not covered by the downwards extension of pleura of pleon segments. Coupling hooks are absent, but each sympodite bears two entangling setae on the inner side, carried on a slight ridge, the upper seta being long and the lower one very short. Exopodites and endopodites are smooth and free from plumose setae. Lobe on exopodite is very laterally displaced. Endopodites are very reduced and cleft in the middle. Unlike other Phreatoicids, the posterior pleopods are not much shorter than the anterior ones. First three pairs are sub-equal,

fourth slightly shorter and broader than the first and the fifth is a little shorter than the fourth.

First pleopod (fig. 1) has an elongate oval, smooth exopodite (*exo.*) whose apex is somewhat narrow. The endopodite (*end.*) is about half as long as the exopodite and very narrow. A median longitudinal cleft extends from the distal extremity, up to one third the length of the entire endopod, giving it an appearance of a 'tuning fork'. The exo- and endopod are free from setae or cilia.

Exopodite of second to fifth pleopods is bilobed. In the second pleopod (fig. 2) the exopodite, which is slightly longer than that of the first, is broadly, triangular with a narrow rounded apex. Its outer margin is almost straight, and is produced proximally. The inner margin is oblique up to two-thirds of its length, where it meets the shaft that bears the lateral lobe (exo. l.). The lateral lobe is long and narrow and springs from a triangular shaft, which projects from the inner margin in the basal third of exopod. The lobe is narrow basally and broadens out apically. External to the insertion of the lobe, the shaft bears numerous simple spines. The endopodite in female is similar to that of the first pleopod. In males, however, endopodite of second pleopod bears a complex penial stylet (fig. 2, *pe. st*). In this pleopod, the endopodite is long and consists of a muscular peduncular region and a distal forked portion, with a feeble constriction at the junction of the two regions. The penial stylet springs from the apex of the peduncular region, and, except at the point of attachment, is completely free from the endopodite. The muscular base of the stylet lies apposed to the endopod for some distance, beyond which it takes a sharp downwards bend. The body of the stylet consists of a thick muscular rim, enclosing a membraneous area. The inner margin (which is away from the endopodite) is strongly convex and thick, and projects beyond the straight outer margin (facing the endopod) in the form of a beak. The margin facing the endopodite is thin and straight and there is a stout spine at the angle where the outer and inner margins meet. The inner margin bears three less stout spines. Third pleopod (fig. 3) appears to be somewhat larger than the preceding two. It is similar in structure to the second pleopod of female. Fourth (fig. 4) and fifth (fig. 5) pleopods are slightly shorter, fifth being the shorter of the two. They are similar to the third but both the exopod and endopod are broader, more rounded and less elongate.

Uropoda (Pl. XVII, figs. 4, 5, 10 and 11).—Peduncle (figs. 4, 5, 10 & 11, *u.p.*) is short and stout and extends beyond the telsonic edge. Its inner mesial edge is ridged and fringed with a few short, stiff setae, and the disto-mesial angle is produced into three large tubercles. Outer ramus (*o.r.*) of uropod is longer than the inner. It is lamellar and narrows towards the apex, which bears a tuft of long spines. Inner ramus (*i.r.*) is short, stout and style shaped. It is broad basally and tapers towards the apex. It bears on the outer margin sub-apically, a few short setae. In adult males (fig. 10) the outer ramus is very long, and may be one and a half times as long as the tail-piece. In females, the outer

ramus (figs. 4 & 5) is much shorter than the tail-piece, although still longer than the inner-ramus.

Females.—Females are smaller in size than males. They do not differ much from the males in general structure, except in the outer ramus of the uropod, which is shorter than the tail-piece. There are four pairs of oostegites on peraeopods one to four. Each oostegite is as long as the basis, and broadly quadrangular in shape.

Early Stages.—There are numerous young specimens in the collection. In the smallest example about 7·0 mm. in length, the outer ramus of uropod is very short, being hardly longer than the inner ramus. As growth proceeds, this ramus (outer) increases at a faster rate than the tail-piece, the differential growth being much faster in the males, than in the females. Sex can be determined at a very early stage, by the presence of tiny bud like penes on the coxae of seventh peraeopods and also by the penial stylet, which appears as a pea-shaped, small outgrowth in the peduncular region of the endopodite of second pleopod of males.

Size.—The largest male example in the collection measures 25·6 mm. Mature males vary in length from 20·0 mm. to 25·0 mm. The largest female with brood pouches measures 16·0 mm.

Holotype.—1♂, Regd. No. C2898/1, Zoological Survey of India, Calcutta.

Paratypes.—Numerous ♂♂ and ♀♀, No. C2899/1, Zoological Survey of India, Calcutta.

Type locality.—Banaras. The holotype and paratypes were collected from the well in the outer lawn of the Kaiser-Castle, Banaras Cantt.

Colouration.—Living specimens were semi-transparent. Specimens preserved in spirit are white.

Habits.—Specimens of *Nichollsia kashiense* can be kept alive in laboratory for months, if the water in the vessel containing them is regularly changed. This species has so far been obtained in wells with very clear water free from carbondioxide and other impurities, and can not probably tolerate dirty or stagnant water. One specimen which was kept in a jar containing a small quantity of cooked rice was attacked by fungus and died within three days.

This species does not swim as gracefully as many other Isopods and it moves about in water by a series of wriggling movements of the body. Specimens kept in laboratory aquaria mostly crawled about around the edge on bottom and rarely came up to the surface of water. As in other Isopods, the first four pairs of legs are directed forwards during locomotion and these serve to hold the substratum while the posterior three pairs, which are directed backwards, appear to push the animal forward. The gnathopods usually do not take part in walking, but are raised up to the level of maxillipedes. Sometimes the animal flexes its telson below the abdomen and proping it against the substratum, turns over completely. While crawling on the bottom the flat ventral surface of tail-piece rubs against the substratum and the outer rami of uropods are fanned out. The middle of the body is slightly raised up in

the form of hump when the animal crawls. The pleopods show very feeble movements and probably serve as respiratory organs only.

Gnathopods appear to be used for digging up food matter. Usually while crawling, the dactyli of gnathopods stir up the substratum and by a simultaneous movement of the mouth parts, food particles appear to be drawn in. Examination of the contents of intestine revealed mostly particles of red sand which forms the bottom of wells in Banaras. It is, however, interesting to record that one batch of specimens kept under observation in the laboratory had nibbled at the surface of the paper label that had been placed in the jar containing them.

N. kashiense does not appear to show any marked reaction to light. Specimens kept in partial darkness did not show any particular preference to it, but moved about equally freely in the brightly lit and the darkened portions of the jar.

Specimens of *N. kashiense* kept in a jar containing red sand at the bottom did not show any tendency to burrow, although they often entered a small glass tube which had been placed on the bottom of the jar.

This species has only been obtained from wells so far, and attempts to obtain it from other habitats have proved unsuccessful.

Distribution.—Wells in Banaras and Lohgara (Allahabad District), U. P. It is possible that the species has an extensive distribution in underground waters of the Gangetic plains.

Remarks on affinities.—The absence of other Phreatoicid material for comparison at our disposal has made it somewhat difficult for us to define clearly the relationships of our new genus *Nichollsia* with other known members of this group. Though this genus has an extremely specialised habitat, in which it has probably been living for a long time, the fact that many unrelated or remotely related genera of this diverse sub-order sometimes show striking similarities, which can only be accounted for by convergence, has further added to our difficulties.

Subterranean Phreatoicids show certain features in common. All the three previously known subterranean genera of the family Amphisopidae, *viz.*, *Hyperoedesipus* (sub-fam. Mesamphisopinae), *Hypsimetopus*, and *Phreatoicoides* (sub-fam. Hypsimetopinae), have a slender vermiform body, reduced pleural extensions of pleon, tendency towards loss of setae on pleopods, lateral displacement of the lobe on the exopodite of pleopods and reduction of the endopodite of the same. *Nichollsia* exhibits all these characters in a more or less aggravated form. In this genus the body is comparatively more slender than that in the above-mentioned three genera, the exopodite of pleopods has completely lost the setae, endopodite is very much reduced and smooth and lobe on the exopodite is more laterally displaced. If any gradation in the characters referred to above is an indication of the time at which a genus took to subterranean habitat, then *Nichollsia* is probably the oldest denizen of underground waters. The Hypsymetopines probably took to this habitat somewhat later, and *Hyperoedesipus* was, perhaps, the last to go down.

Besides the common features mentioned above, *Nichollsia* exhibits certain other structural similarities, of a somewhat remote nature, with these genera. With *Hyperoedesipus*, *Nichollsia* shares the short and free first peraeon segment, long truncated tail-piece and general structure of the head and mouth parts. In this connection it is interesting to record that in very young examples of *Nichollsia*, the mandibles are as forwardly placed as in *Hyperoedesipus*. The pattern of mouth parts conforms to the same general plan as in *Mesamphisopus capensis* (Barnard) but the differences between the two are rather too marked to suggest any close affinity between the Mesamphisopinae and the Nichollsinae.

Whereas in the structure of cephaloperaeon and its appendages, *Nichollsia* resembles to some extent the Mesamphisopinae, the Nichollsinae appears to be much nearer to the Hypsimetopinae in the structure of pleon and its appendages. The common characters here are the absence of coupling hooks on the sympodites of pleopods, the presence of a few entangling setae on the sympodite, curved short peinal stylet, an antero-dorsally articulated tail-piece and four pairs of oostegites in females. *Nichollsia*, however, can neither be accommodated in the sub-family Mesamphisopinae, because of the absence of coupling hooks on the sympodites of pleopods, nor in the Hypsimetopinae on account of the short first peraeon segment free from the head.

The long filiform antennule of *Nichollsia* is not met with in any of the other subterranean forms, but is a character of Amphisopinae and Phreatomerinae (Nicholls, 1943*a*, p. 86).

The characters which are confined to *Nichollsia* alone are proportionately long pleon-telson, forked endopods of pleopods and the sub-equal posterior pleopods. The structure of uropods of *Nichollsia*, as already described, is very peculiar. The outer ramus of uropod is longer than the inner and in adult males it is enormously elongated. In young ones, however, the outer ramus is rather short, although still slightly longer than the inner, a condition which approximates to that of the sub-equal rami of *Onchotelson* Nicholls (1943*b*, p. 86).

From what is stated above, it is obvious that *Nichollsia* is a very specialised genus of Phreatoicoidea, although certain primitive features can still be noticed. Its position appears to be intermediate between *Hyperoedesipus* and Hypsimetopine Amphisopids and assuming that all these forms have evolved from a generalised type of common Gondwanaland ancestor, it appears likely that divergence from the ancestral type and independent development along different directions must have started very early.

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