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On certain species of *Palaemon* from
South India.

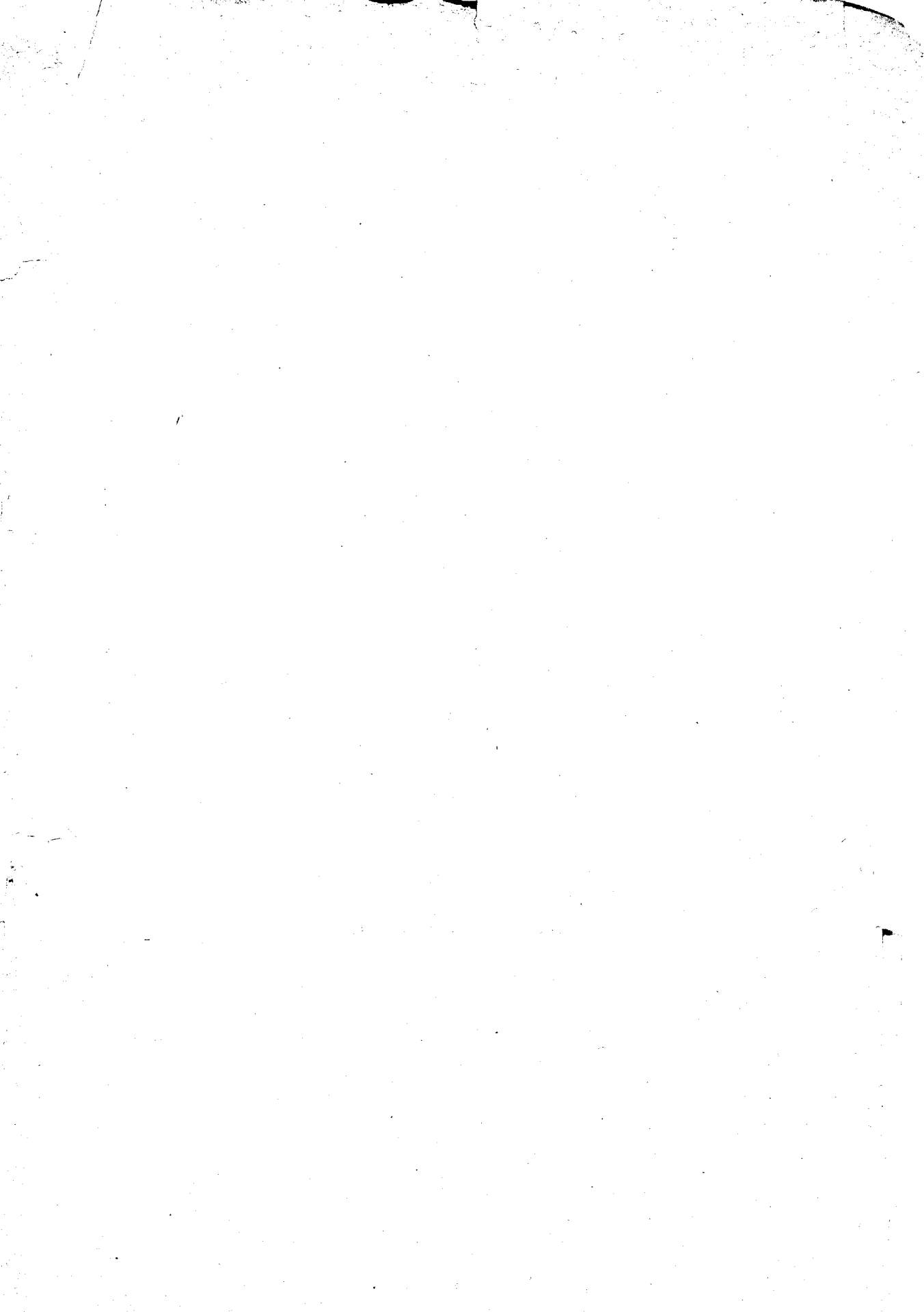
By
J. R. HENDERSON
and
G. MATTHAI.

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XXVIII. ON CERTAIN SPECIES OF
PALAEON FROM SOUTH INDIA.

By J. R. HENDERSON, M.B., F.L.S., and GEORGE
MATTHAI, M.A.

The collection of freshwater prawns on which the following observations are based is one formed during a number of years, and comprising specimens collected at various localities in the Madras Presidency, from Ganjam to Tranquebar on the east coast, and from Mangalore to Travancore on the west coast. In most of the species reported on, a large series of individuals has been obtained at all stages of growth. Altogether nine species are described, and of these two are regarded as new to science, while in the present state of our knowledge of the genus, and as a matter of convenience, we have considered it advisable to assign a name to a third form which may prove to be only a variety of a previously known species.

Species of *Palaemon* are found abundantly throughout Southern India, wherever there are more or less permanent tanks (ponds and lakes) or rivers. We have obtained *P. carcinus* from the back-water at Cochin, but with this exception have not met with any of the other species in salt water. Freshwater prawns form an article of food among the poorer classes, but in this respect are inferior to marine prawns (*Penaeus*).

Comparatively little attention has been paid to the Indian species of *Palaemon*. Forms from Central and Northern India have been described by Milne-Edwards, Henderson, and de Man, while for Southern India there is the original description of the genus by Fabricius (Supplem. Ent. Syst.) and a recent paper by the late Dr. Giuseppe Nobili (Boll. Mus. Zool. Torino). Fabricius in 1798 described three species from South India, *P. tranquebaricus*, *P. brevimanus*, and *P. coromandelianus*, but the diagnoses are so brief that the forms are unrecognisable; all three probably occur among the species which we are about to describe. Nobili records seven species from Pondicherry, but this number can be reduced to five, all of which are present in our collection. The only one to which he assigns a new name, *P. alcocki*, is, we are convinced, a young example of probably *P. rudis*, Heller. He also briefly describes a single small specimen which he refers to *P. multidentis*, Coutière, from Madagascar. It is impossible to identify this last from Nobili's description, but in any case a reference to Coutière's paper shows that his species was undoubtedly based on immature specimens, and in our opinion the name should be suppressed.

Owing to the great differences which exist between young and old individuals, and between the two sexes, considerable difficulty is often experienced in determining the species of *Palaemon*. As a rule, new species should not be described in the absence of a series of individuals of both sexes at different periods of growth, and certainly never from individuals which do not appear to be adult. In some cases where adult males show clearly marked differences, e.g., *P. rudis* and *P. idae*, very young individuals of the same species are almost indistinguishable, and the adult females can only be separated with considerable difficulty. Descriptions of new species which have not been largely based on an examination of adult males are therefore likely to be misleading, and lack of attention to this general principle has largely contributed to the numerous synonyms with which the genus *Palaemon* is overburdened.

The most reliable specific characters are those derived from the form and relative length of the joints in the larger chelipedes of adult males, and the general form and tothing of the rostrum in both sexes. In opposition to Ortmann we do not attach much importance to the shape of the telson-tip, which sometimes varies greatly in members of the same species; but we find that useful characters can frequently be obtained from the relative lengths of the two sub-terminal spinules when compared with the telson-tip. The division of the genus into four groups, *Eupalaemon*, *Brachycarpus*, *Parapalaemon* and *Macrobrachium*, which has been proposed by Ortmann, is of doubtful utility, for the characters on which they are founded depend to some extent on the age of the individual. Thus *P. scabriculus*, when young is a *Eupalaemon*, when older a *Parapalaemon*, and very old males might be placed in the group *Macrobrachium*.

In the case of our species the examination of a large number of individuals of different sizes seems to establish the following facts in regard to the modifications of structure which accompany growth:—

1. The rostrum in the young is relatively longer than in the adult.
2. The larger chelipedes, always shorter than the body in the young, are usually much longer than the body in the adult. In species with the chelipedes of the second pair very unequal, the latter part of this statement only applies to the larger chelipede.
3. The merus and carpus of the larger chelipedes as a rule remain of the same relative length.
4. The ischium grows much more slowly than the merus and carpus, with the result that while in the young it is either equal to or longer than the merus, in the adult it is always shorter than the merus.
5. The palm grows much faster than the merus, carpus and fingers, so that while usually shorter than the carpus

in the young, it equals or sometimes even exceeds the latter joint in the adult.

6. The fingers (except in the case of *P. idae*) grow a little more quickly than the carpus and merus, but less rapidly than the palm.

The following sexual characters, though common to other *Macrura*, are of some practical importance; the thoracic legs of the female are not so approximate at their bases as in the male, and this is particularly the case with regard to the last pair of legs; the ventral surface of the abdomen is also wider in the female, and the abdominal epimera which form a lateral protection for the eggs attached to the abdominal appendages, are of greater depth, especially those of the first three segments. Of much greater importance, however, are the special sexual characters of the genus. The female is smaller than the male. The rostrum in the female is usually comparatively longer than in the male, and in species in which it is upturned distally that of the female is more distinctly curved. The chelipedes in the female are always much thinner and shorter than those of the male. The spinosity and pubescence of the chelipedes, carapace and legs, which frequently characterise males, are much less strongly developed and in some cases even totally absent from females. The fingers of the female are of equal length, and the teeth or tubercles on their ridges weak or absent, while their tips are less curved than those of the male. Coutière has drawn attention to an apparent preponderance of males in the genus *Palaemon*, but we imagine that this is partly due to a process of selection by collectors, for in most of our species females were met with in as great numbers as males.

The subject of dimorphism in the males of *Palaemon* is one of considerable interest. While the young individuals of any species are all very much alike, it is not till a later stage, when the maximum size of the individual is practically attained, that the male characters definitely assert themselves. In many if not in all species, two forms of male are to be met with, *viz.*, normal males usually of considerable size, with the larger chelipedes specially developed, and males of the second type ("mâles féminisés" of Coutière) generally smaller but sometimes attaining the same size as normal males, in which the chelipedes resemble those of females.

Dimorphism of the males has been recorded in several species of Decapod Crustacea, and it has been shown, notably by Faxon in crayfishes of the genus *Cambarus*, that the two forms represent breeding and non-breeding stages, which alternate in the life history of each individual. In order to ascertain if any similar alternation exists in *Palaemon*, we have recently (September and October) examined the reproductive organs of a large number of males of *P. malcolmsonii*, *P. dubius*, and *P. scabriculus*, but with negative results. We find that in these three species many males of the second type, with the larger chelipedes undeveloped, appear to be sexually mature; their testes are well-developed, and in all

those examined free spermatozoa were found in the vasa deferentia. In normal males similar conditions were met with, but the testes were proportionately larger, and the vasa deferentia more coiled. We met with free spermatozoa in a male of *P. dubius*, which measured only 37 mm. in total length, with the chelipedes subequal and only about half the length of the body, yet the general appearance of this specimen, and more particularly of its chelipedes, would have led to the assumption that it was a young individual. A specimen of *P. malcolmsonii*, measuring only 93 mm. in total length, with chelipedes considerably shorter than the body, contained free spermatozoa in abundance in the vasa deferentia. The spermatozoa of *Palaeomon* have a single process springing from a head, the free surface of which is convex, so that the whole structure bears some resemblance to an umbrella.

With regard to the last three forms on our list, *P. scabriculus*, *P. dolichodactylus*, and *P. dubius*, we have encountered problems of considerable perplexity, and are strongly disposed to think that they may all belong to one and the same species. Specimens of all three forms of adult male were taken together in the same tanks, along with adult females which appeared to be all of one type, and a careful examination failed to reveal any differences among them such as one would have expected had there been three species. Very young males collected under the same conditions were also alike, and finally there appeared to be connecting links between the three forms of adult male. If our view, which amounts almost to a conviction, can be established, we have here to deal with a species in which the males exhibit polymorphism, and we would hazard the opinion that a number of the so-called species of *Macrobrachium* are based upon similar varieties of male.

In some of the species there appears to be considerable variation in the size of adult individuals. In *P. malcolmsonii*, we have females with eggs ranging in total length from 90 mm. to 118 mm., and our largest female (one without eggs) measures 133 mm. In this species we also find males with all the special characters developed, from 191 mm. to 230 mm. in length.

Parasites and commensals are occasionally met with on some of the species. A *Probopyrus* is met with, sometimes abundantly, on *P. malcolmsonii*, inhabiting the branchial chamber of either side, and we have found a similar parasite in single specimens of *P. rudis* (right side) and *P. scabriculus* (left side). In all cases the infected host suffers an arrest in growth, and the male chelipedes resemble those of females, an observation which has frequently been made with regard to other instances of parasitism in Decapod Crustacea. Specimens of *P. malcolmsonii*, from the neighbourhood of Madras, are occasionally found with the chelipedes, carapace, and abdominal terga, covered by algae, and the polyzoon *Victorella bengalensis*, Annandale.

In the descriptions which follow the total length of the prawn is taken from the tip of the rostrum to the apex of the telson. In the measurements of the chelipedes the coxa and basis are not

included. All measurements are in millimetres, and are taken in the case of joints from the dorsal side. The *ischium*, *merus*, *carpus*, *palm*, and *fingers* of the large chelipedes, are indicated respectively by their initial letters i., m., c., p., f.; the abbreviations im. f., and m. f., stand for the *immobile* and *mobile* fingers respectively.

The term *young* as applied by us includes specimens with the chelipedes shorter than the body; it does not necessarily imply that the individuals are sexually immature.

PALAEEMON CARCINUS, Fabricius.

(Pl. xv, figs. 1a—g.)

P. carcinus, Fabricius, Suppl. Ent. Syst., p. 402 (1798); Milne-Edwards, Hist. Nat. des Crust., t. ii, p. 395 (1837); Ortmann, Zool. Jahrb. Syst., Bd. v, p. 700 (1891); de Man, in Max Weber's Zool. Ergebn., p. 421 (1892).

Characters of adult males.—The rostrum is long, and exceeds the antennal squame by nearly one-fifth of its length; it is bent near the middle and upturned distally. The tooth formula is 12 to 15 (most commonly $\frac{12 \text{ to } 13}{11 \text{ to } 13}$); the seventh to the eleventh teeth are usually separated by wider intervals than the others. The first three upper teeth, or rarely the first two, are on the carapace.

The large chelipedes are sub-cylindrical and either equal or sub-equal; they are nearly half as long again as the body; a longitudinal pale line traverses the upper and lower surfaces of the palm, carpus, and sometimes the merus. The joints are beset with broad-based spines, which are less strongly developed on the ischium and the immobile finger, and absent from the mobile finger. The distal end of the carpus is about the same width as the palm, while the latter is of uniform width. The finger-tips are strongly incurved, more especially that of the mobile finger. The mobile finger is stouter than the immobile finger, and is densely pubescent, a fact which causes it to look stouter than it really is. The tooth on the immobile finger is conical, while the crenation of the ridge situated proximally to this tooth is well pronounced; the proximal tooth of the mobile finger may, in some cases, be followed by a small tubercle. When the fingers are closed, the tooth on the immobile one lies nearer the proximal than the distal tooth of the mobile finger. The following measurements are taken from the chelipede of an adult specimen (dried) measuring 295 mm. in total length:—

i. 38 m. 85 c. 110 p. 112 f. 89.

The telson-tip is acutely pointed; the inner sub-terminal spinule on each side projects backwards beyond the outer one, but does not nearly reach the tip of the telson itself.

The whole surface of the body is conspicuously punctate, but this characteristic is less marked on the carapace.

The colours of fresh specimens are as follows :—Deep peacock blue on the large chelipedes, passing into green on the palm and fingers; this coloration is absent from the coxal and basal joints, and is deeper on the upper than on the under surface. The ambulatory legs are pale blue; the spines on the legs are deep blue at the base, and orange towards the apex. The body is flesh-coloured; the abdominal segments have deep blue transverse bands, which are broadest on the fourth, fifth and sixth segments.

Characters of females.—The rostrum is more strongly upturned distally, and is somewhat less deep than in adult males.

The large chelipedes are more than half the length of the body; they are beset with feebly developed spines, those on the ischium and fingers being the weakest, while there are none on the mobile finger. The palm is slightly compressed dorso-ventrally, and is about the width of the distal end of the carpus. The mobile finger is stouter than the immobile, but not to the same extent as in males, nor is it so densely pubescent. When the fingers are closed, the distal tooth of the immobile finger lies midway between the two teeth on the mobile finger.

The following measurements show the length of the joints of the large chelipedes in an adult female (dried) measuring 232 mm. in total length :—

i. 35 m. 32 c. 43 p. 35 f. 27.

Characters of young individuals.—In specimens under 200 mm. in total length the rostrum closely resembles that of the adult female.

In an individual measuring 139 mm. in total length, the joint measurements are as follows :—

i. 17.5 m. 16 c. 20 p. 17 f. 14.5.

With advancing age the coloration of the body deepens, the mobile finger becomes much stouter than the immobile, the pubescence appears on the former, and the punctation on the body becomes more pronounced.

This species is the largest, and one of the best known members of the genus. It has been recorded from many localities in the Indo-Malayan region, from India to New Guinea, and has been so often and so fully described that a fuller description than that given above is unnecessary.

Localities.—From many localities in the Malabar District, Cochin State, Travancore State; Godaveri District (Rajahmundry and Cocanada); Chingleput District (Red Hills and other localities near Madras). We have obtained adult males and females from the back-waters of the Cochin State near Ernakulam, a fact which is of some importance since the genus *Palaemon* is chiefly met with in fresh water.

P. MALCOLMSONII, H. Milne-Edwards.

(Pl. xv, figs. 2a—f.)

P. malcolmsonii, H. Milne-Edwards in Jacquemont's "Voyage dans l'Inde," Crustacés, p. 8, pl. iii (1844).

P. danae, Nobili, Boll. Mus. Zool. di Torino, vol. xviii, n. 452, p. 7 (1903).

Characters of adult males.—The rostrum projects beyond the antennular stalk for about one-fifth of its length. Its upper margin consists of a toothed highly convex proximal part, and a much shorter more or less straight distal part, which carries only one or two teeth near the apex. The proximal portion is relatively deep, while the terminal portion is much narrower. The tooth formula is $\frac{9 \text{ to } 11 + 1}{5 \text{ to } 7}$ or 2 (most commonly $\frac{10 \text{ to } 11 + 1}{6}$).

As in *P. carcinus* the first three upper teeth or rarely the first two are on the carapace.

The large chelipedes, which are sub-equal in length, resemble those of *P. carcinus*, but the spinules are not so strongly developed, and are more closely set; the movable finger is somewhat less pubescent; the chelipedes are less than double the body-length. A groove traverses both the upper and lower surfaces of the palm and carpus, recalling the longitudinal lines visible in *P. carcinus*. The following measurements are taken from the chelipede of an adult specimen (dried) measuring 191 mm. in total length:—

i. 44 m. 71 c. 95 p. 86 f. 46.5.

From the above measurements, it will be seen that the ischium and fingers are both relatively shorter than in adult males of *P. carcinus*.

The telson-tip, as in *P. carcinus*, is acutely pointed. The inner sub-terminal spinule on each side projects backwards beyond the outer one, but does not nearly reach the telson-tip.

The anterior surface of the carapace, the postero-ventral regions of the first five abdominal epimera, the anterior region of the second abdominal epimeron and sometimes of the first, fifth and sixth abdominal terga, and the upper surface of the telson are scabrous. The thoracic legs, with the exception of their dactyli, are provided with very numerous closely set spinules.

Characters of females.—The rostrum may be slightly upturned distally, and extends as far as, or a little beyond, the distal margin of the antennal squame; sometimes the upper penultimate tooth is midway between the ultimate and antepenultimate teeth.

The large chelipedes are scabrous, and are about two-thirds the length of the body. The palm is slightly compressed dorso-ventrally, and is of uniform width; it is as wide as, or slightly wider than, the distal end of the carpus. The mobile finger is not pubescent. The grooves on the carpus and palm which are charac-

teristic of males are absent in the female. In a specimen measuring 118 mm. in total length, the joint-measurements are as follows:—

i. 16 m. 15 c. 19 p. 16 f. 11.

The body is smooth and exhibits none of the roughness characteristic of males.

Females with eggs vary from 90 to 118 mm. in total length; the largest specimen from Tanjore is without eggs, and measures 133 mm. in length.

Characters of young individuals.—In individuals under 110 mm. in total length the rostrum may be slightly upturned distally, and may extend a little beyond the distal margin of the antennal squame.

A table of measurement taken from male individuals is given, to show the changes which accompany growth in regard to the relative lengths of the joints of the large chelipedes.

No.	Locality.	Total length of body.	Total length of chelipede.	LARGE CHELIPEDA.				
				Ischium.	Merus.	Carpus.	Palm.	Finger.
I	Bezawada ..	68	34.75	8	7	8.75	6	5
II	Chingelput ..	73	46.5	9.5	9	12	9	7
III	Surada reservoir ..	87	62	12.5	12.5	16	12	9
IV	„ ..	98	89.75	15.5	18	23.75	18.5	14
V	„ ..	118	127.25	20	24.75	32	28	22.5
VI	Godavery River ..	131	142.5	22.5	25.75	33	33	28.25
VII	Karoor ..	155	171.5	28	33	41	40	29.5
VIII	Tanjore ..	191	342.5	44	71	95	86	46.5
IX	Renigunta ..	230	442	51	92	115	115	69

No. VIII in the above table, though much smaller than No. IX, presents adult characters, and hence it appears that there is considerable variation in size in adult males also.

General remarks.—*P. danæ*. Heller, judging from the original figure, is perhaps based on young specimens of *P. malcolmsonii*. Nobili has referred to *P. danæ* certain specimens from Pondichery, the largest of which measured 65 mm. in total length; these we have little doubt in regarding as young individuals of *P. malcolmsonii*. *P. weberi*, de Man, which is undoubtedly a distinct species, agrees closely with *P. malcolmsonii* in the shape and toothings of the rostrum. It is extremely probable that the common South Indian species described above, was one of those originally diagnosed by Fabricius, and we possess a well-developed male specimen from Tranquebar, the locality which furnished the Danish naturalist with his type specimens. It is impossible, however, to determine from his brief descriptions to which of the species it belongs.

Localities.—This species, originally described by Milne-Edwards from Nagpore, is the commonest freshwater prawn in Southern India. It has not so far been recorded from any locality

outside India. We have a large number of specimens from the following localities:—

Ganjam District (Surada Reservoir and Berhampore), Kistna District (Bezawada Anicut), Godaveri District (Rajahmundry), Madras District, Chingleput District (Chingleput, Pallavaram, Red Hills and Walajabad), North Arcot District (Renigunta), Trichinopoly District (Trichinopoly), Tanjore District (Tanjore and Tranquebar), Coimbatore District (Karoo).

We have not so far obtained any specimens from the Western side of India.

P. IDÆ, Heller.

(Pls. xv, figs. 3a—c, and xvi, figs. 3a—l.)

P. idæ, Heller, Sitz.-Ber. Akad. Wiss. Wien, Bd. xlv, p. 416, tab. ii, figs. 40, 41 (1862); Ortmann, l.c., p. 717 (1891).

P. sundaicus, Heller, l.c., p. 415, tab. ii, figs. 38, 39 (1862); Ortmann, l.c., p. 719 (1891); de Man, in Max Weber's Zool. Ergebn., p. 437, tab. xxvi, fig. 35, p. 437 (1892); Nobili, l.c., p. 8 (1903).

Characters of adult males.—The rostrum extends as far as, or a little behind, the distal margin of the antennal squame; its proximal portion is deep, and shows slight convexity above, while the narrow terminal part is straight or slightly upturned. The tooth formula is $\frac{12-15}{4-6}$ (most commonly $\frac{13}{4}$); the first and second upper teeth are separated by a wider interval than any of the others, and these, with in rare instances a third tooth, are on the carapace. The two distal teeth are separated by a narrower interval than the other teeth, while a somewhat wide gap separates the first of these from the proximal series; in some cases there are three teeth in the distal series, and very exceptionally four teeth.

The large chelipedes are slender, sub-cylindrical, and sub-equal; their length is more than one and a half times the length of the body. The joints are beset with short blunt almost tubercular spines, which, however, are feebly developed on the ischium and fingers. These tubercles are arranged in approximately longitudinal rows. The proximal portion of the carpus is of the same width as the palm, while its distal portion is wider than the latter. The palm is very slightly compressed laterally at its distal end. The fingers are usually of equal thickness, and the finger-tips are incurved; the inner margin of the immobile finger, and the whole surface of the mobile finger are pubescent; the ridges on the opposed edges of the fingers are less strongly developed than in *P. carcinus* and *P. malcolmsonii*. The tooth on the immobile finger is acute, and in some male specimens from Mangalore, the front margin of the teeth on the fingers is somewhat convex; the teeth on the mobile finger are not so wide apart as in *P. carcinus* and *P. malcolmsonii*; and the proximal tooth is less prominent than

the distal one. When the fingers are closed, the tooth on the immobile finger lies nearer the distal than the proximal tooth of the mobile finger. In a specimen measuring 111 mm. in total length, the following are the measurements of its large chelipedes:—

	i.	m.	c.	p.	f.
R. chelipede ..	25	33	67	40	23
L. chelipede ..	25	33	66	39	22.5

It is to be noted from the above measurements, that the carpus is longer than the propodus, and that the fingers are a little more than half the length of the palm.

The Mangalore specimens in our collection have comparatively longer and more slender chelipedes than those from Malabar.

The telson is broad towards the apex with a short median point. The inner sub-terminal spinule on each side projects beyond the tip of the telson by about half its length; the much shorter outer lateral spinule does not reach the tip.

Minute tubercles are present on the anterior surface of the carapace, the exposed dorsal surface of the last pair of abdominal appendages, the ventral surface of the exopodites of the same pair of legs, the telson and the sixth abdominal segment, and the ventral and posterior margins of the abdominal epimera, especially of the second, third and fourth segments. The presence and distribution of these tubercles are of specific value.

Characters of females.—The number of teeth on the almost straight upper margin of the rostrum varies within greater limits (11 to 15). The large chelipedes are slightly scabrous and are about two-thirds the body-length. A few setæ are irregularly distributed on the fingers which are otherwise naked. The palm is as wide as, or slightly wider than the distal end of the carpus. The following measurements are taken from the large chelipedes of an adult female measuring 89 mm. in total length:—

i. 12.5	m. 11	c. 20	p. 13	f. 11.
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From the above measurements it will be seen that the carpus is slightly shorter than the propodus,¹ and the fingers longer than in the male. Adult females vary from 70 to 90 mm. in total length. The single female specimen (with eggs) from Mangalore measures 78 mm. and the joint-measurements of its right chelipede are as follows:—i. 12 m. 12 c. 21 p. 13 f. 8 mm. As in the case of the male specimens from the same locality, the chelipede of the female is relatively longer than that of female specimens from Malabar. The Mangalore examples might almost be regarded as constituting a distinct variety of *P. idæ*, but the differences are not sufficiently great in our opinion to entitle them to specific rank.

Characters of young individuals.—The proximal portion of the carpus is narrower than the palm, while its distal portion is as wide

¹ The reader is reminded that our initial letter p. stands for palm. The length of the propodus is obtained by adding the measurements recorded for p. and f.

as the latter. The following are the measurements of a young specimen measuring 72 mm. :—

	i.	m.	c.	p.	f.
R. chelipede ..	13.5	14.5	26	15	11
L. chelipede ..	13.5	14	24	14.5	10.5

General remarks.—On comparing this species with Heller's description and figures, we find that it agrees in a great many respects with *P. idæ*. The large chelipedes have the same general build, and the joints show almost the same relative lengths. The following differences, however, appear to exist :—Heller states that the inner margins of the fingers are toothless, and that the tooth-formula is $\frac{10 \text{ to } 11}{4 \text{ to } 5}$, while his figure shows the large chelipede to be stouter. Hilgendorf's figures based on specimens from Zanzibar which he refers to *P. idæ*, seem to agree with those of Heller except that the tooth-formula is $\frac{9}{3}$, and the chelipedes are even stouter than in Heller's figure.

Von Martens thinks it probable that *P. sundaicus*, Heller, from Java, in which the carpus is shorter than the propodus, is the young of *P. idæ*. Ortmann rejects von Martens' view on the assumption that the carpus, which, in the young, is already shorter than the propodus, can never, as a result of growth, exceed it in length; while this observation is true of most species of *Palaemon*, we have reason to believe that it does not apply to the present one. From observations carried out on a large number of specimens, we are able to state that the fingers in the present species elongate less rapidly with advancing age than do the merus and carpus, and the palm does not grow so quickly as it does in *P. carcinus* and *P. malcolmsonii*, with the result that in adult males the carpus is longer than the propodus. Our observations, therefore, seem to corroborate von Martens' supposition. Moreover young male individuals and females of the Indian species which we refer to *P. idæ*, agree closely with Heller's description and figures; his specimen, which was probably a female, measured 3 inches in length.

While Heller's account of *P. sundaicus* appears in his paper before that of *P. idæ*, the latter name is preferable, because the description is based on the characters of an adult male, while some uncertainty must attend the identification of the former based as the species is on a female specimen.

Nobili has referred to *P. sundaicus* a single specimen from Pondicherry, which measured 55 mm. in total length, with the rostral formula $\frac{11}{5}$.

P. lanceifrons, Dana, originally recorded from Manila, in which the carpus nearly equals the palm in length, is perhaps also the young of *P. idæ*, but in a slightly more advanced stage than

P. sundaicus. Ortmann, however, refers to *P. lanceifrons*, a specimen from Ceylon measuring 85 mm. in total length (Dana's original specimen measured only 55 mm.), in which the carpus and palm are sub-equal, and he argues as in the case of *P. sundaicus*, that the differences between the two examples in the relative lengths of the carpus, palm, and fingers, are accountable by the greater growth of the Ceylon specimen

The following measurements taken from the large chelipedes of male individuals show the changes which accompany growth in regard to their relative lengths:—

No.	Locality.	Total length of body.	Right or left.	LARGE CHELIPEDES.						
				Total length of chelipede.	Ischium.	Merus.	Carpus.	Palm.	Finger.	
I	Mangalore	67	R		Missing.					
			L	108.5	14.5	19	37	24	14	
II	Kottayam	72	R	80	13.5	14.5	26	15	11	
			L	75.5	13.5	14	24	14.5	10.5	
III	Mangalore	73	R		17.5	25.5	47			
			L	136.5	17.5	25.5	46.5	31	16	
IV	Cochin ..	77	R	91.5	13.5	17	29	20	12	
			L	71.5	12	14	21.5	15	9	
V	,, ..	79	R	89	13.5	16	28	20	11.5	
			L	84.75	13	15.25	27	18.5	11.5	
VI	,, ..	88	R	134.5	18.5	24	47	28	17	
			L	132.5	18.5	24	45	28	17	
VII	,, ..	89	R	142	18.5	25	48	32.5	18	
			L	145.5	18.5	26	49.5	33	18.5	
VIII	Calicut ..	91	R	145	19	25	51.5	31	18.5	
			L	139.5	19	24	48.5	30	18	
IX	Trichur ..	103	R	196.5	25	34	71	44	22.5	
			L	188.5	24.5	35	67	41	21	
X	Palghat ..	104	R	184	23.5	33	61.5	46.5	19.5	
			L	192.5	24	34.5	65	49	20	
XI	Calicut ..	111	R	188	25	33	67	40	23	
			L	185.5	25	33	66	39	22.5	

It is to be noted from the above table that the two Mangalore specimens, though only 67 and 73 mm. in total length, yet possess adult characters and their chelipedes are relatively longer than those of the Malabar specimens. They may, therefore, be regarded as a smaller variety of *P. idæ*. Numbers IX and X, though with shorter body-length than No. XI, have longer chelipedes and in No. X, the propodus is slightly longer than the carpus. The latter was the only example out of a large number examined, of about the same size, which exhibited this peculiarity.

Localities.—Western India. Several specimens of both sexes from South Canara District (Mangalore), Malabar District (Calicut, Palghat), Cochin State (Koll Lands, Cochin), Travancore (Kottayam).

General Distribution.—*P. idæ* has been recorded from Madagascar (Coutière), Zanzibar (Hilgendorf), Dar-es-Salaam (Ortmann), Seychelles and Mauritius (Richters), Ceylon (Heller), Singapore (von Martens), Sumatra (Nobili), Java (von Martens, de Man, Thallwitz), New Guinea (Nobili), Borneo (Heller), and the Philippines (von Martens, Thallwitz). It is recorded from the sea at Java by de Man.

P. sundaicus has been met with in the following localities:—Madagascar (Coutière), Natal, in the sea (Max Weber), Mozambique (Hilgendorf), Zanzibar (Grandidier), Java (Heller, de Man), Flores and Celebes (de Man).

PALAEEMON SULCATUS, n. sp.

(Pl. xvi, figs. 4a—g.)

We refer six specimens from Cochin to this new species, of which one is a female and the rest males. Though possessing some points in common with *P. idæ*, they can yet be distinguished from the latter by certain well-marked differences.

Characters of adult males.—In the largest specimen measuring 93 mm. and in another measuring 84 mm. in total length, the rostrum shows some resemblance to that of *P. idæ*, but the proximal portion of the upper margin is only very slightly convex, and the rostrum extends nearly as far as the distal margin of the antennal squame, with the tooth-formula $\frac{12}{6}$ and $\frac{12}{4}$ respectively. In a third specimen measuring 79 mm. the upper margin is almost straight with the tooth-formula $\frac{11}{4}$; in the fourth specimen measuring 82 mm. the proximal portion is straight, but the distal portion is turned up, with the formula $\frac{11}{4}$; in the fifth specimen, the rostrum extends beyond the distal margin of the squame, and is considerably upturned distally, the three distal teeth are very close to each other, the fourth and fifth teeth are separated by a much wider

gap than the others, and the dental formula is $\frac{12}{5}$. In all these specimens the first and second upper teeth, as in *P. idæ*, are separated by a wider interval than the others, and the two distal teeth are usually situated close to each other; the teeth are stronger and are placed further apart than in *P. idæ*; the first three upper teeth are on the carapace.

The large chelipedes are sub-cylindrical and sub-equal, but in the largest specimen they are unequal, the right one being longer than the left. The palm is as wide as, or slightly narrower than, the distal end of the carpus. The fingers are of equal thickness and their tips are incurved, while the tooth on the immobile finger is acute; in these respects they resemble *P. idæ*. The upper surface of the chelipedes, with the exception of the fingers, is beset with very short and slender forwardly directed spinules, while the rest of the surface is provided with fewer but stronger spinules slightly directed forwards, which are best developed on the lower surface; the longitudinal arrangement of the spinules is specially marked in the present species. A lateral groove free of spinules runs along the outer side of the merus, carpus and palm, being most distinct on the carpus. The characteristic linear arrangement of these spinules and the presence of a lateral groove on the chelipedes are very characteristic of the present species; the specific name is taken from the last mentioned peculiarity. It may be noted that a similar groove is present in *P. lar*, Fabr. A dark brown mottling occurs on the chelipedes more particularly on the fingers. From the largest specimen measuring 93 mm. in total length, the following measurements were obtained :—

Long chelipede (right).

i. 18 m. 25 c. 48 p. 44 f. 22.

Short chelipede.

i. 14 m. 20 c. 29 p. 22 f. 12.

It should be noticed from the above that the longer chelipede is more than one and a half times the length of the body, while the shorter one nearly equals it, and that the carpus is shorter than the propodus, but longer than the palm, while in *P. idæ* the carpus is longer than the propodus.

As in *P. idæ* the inner sub-terminal spinules on the telson project beyond the tip of the latter by about half their length; the much shorter outer lateral spinule does not reach the tip

The anterior surface of the carapace, the exposed upper surface of the last pair of abdominal appendages, and the lower margins of the abdominal epimera are scabrous. The upper surface of the telson is provided with close-set spinules, similar to those on the large chelipedes.

Characters of the female.—It measures 71 mm. in total length. The rostrum has an almost straight upper margin, and extends a

little beyond the antennal squame; the tooth-formula is $\frac{11}{4}$. The large chelipedes are practically equal, and much shorter than the body; the spinules are weaker than in males, but retain the same characteristic arrangement. The lateral groove is well seen on the carpus, but it tends to assume a more dorsal position; whether this is characteristic of all females cannot be determined as there is only a single specimen in the collection. The pubescence on the fingers is similar to that in males but feebler. The joint-measurements of the chelipedes are as follows:—

i. 8 m. 9 c. 12 p. 10 f. 6.5.

The entire surface excepting the chelipedes is smooth, but the telson is slightly rough. The following are detailed measurements of all six specimens:—

Length of— body	♂		♂		♂		♂		♂		♀	
	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.
..	79		82		82		84		93		71	
chelipedes ..	83	86.5	94.5	94	96.5	96	107.5	97	157	97	46.5	45.5
ischium ..	12	12	14	13	14	15	14	13.5	18	14	8	8
merus ..	14.5	14.5	16.5	16.5	18	17	18	17.5	25	20	9	9
carpus ..	23.5	24.5	26	26	29.5	28	29.5	28	48	29	12.5	12
palm ..	21	22.5	24	24.5	21	20.5	29	24	44	22	10.5	10
fingers ..	12	13	14	14	14	15.5	17	14	22	12	6.5	6.5

Locality.—We have obtained this species only from Cochin.

PALAEEMON RUDIS, Heller.

(Pl. xvii, figs. 5a—h.)

P. rudis, Heller, Verh. Z. B. Gesellsch. Wien, p. 527 (1862); Ortmann, l.c., p. 741 (1891); Coutière, Ann. des Sci. Nat. Sér. 8, t. xii, p. 288 (1901).

P. mossambicus, Hilgendorf, Monatsb. Akad. Wiss. Berlin, p. 839, tab. iv, fig. 17 (1878).

P. alcocki, Nobili, l.c., p. 9, fig. 5 (1903).

Characters of adult males.—The rostrum which shows a moderate proximal convexity extends as far as the distal margin of the antennal squame, or a little behind it; the distal portion slopes slightly downwards; the tooth-formula is $\frac{10-12}{4}$. The first two teeth, as in *P. idæ*, are on the carapace, and are separated by a wider interval than any of the others; as a rule the two distal teeth are closer together than any of the others.

The large chelipedes are always unequal; the longer chelipede is a little less than one-and-a-half times the length of the body; the shorter chelipede is about five-sixths the length of the longer one. The chelipedes are everywhere pubescent, but this characteristic is less marked on the ischium, and most pronounced on the opposed margins of the fingers. The palm is practically cylindrical, and is the same width as the distal end of the carpus, or sometimes slightly narrower. The fingers are of equal thick-

ness; as in *P. idæ* and *P. sulcatus*, the tooth on the immobile finger is acute and the proximal tooth on the mobile finger is smaller than the distal one; when the fingers are closed the first of these teeth fits between the other two; the crenation of the ridge of the immobile finger, proximal to its basal tooth, is more prominent than in *P. idæ* and *P. sulcatus*. A row of from 15 to 20 tubercles exists on each side of the median ridge of both fingers, and is exposed on removal of the pubescence; sometimes it is found only on one side of the ridge; this character and the pubescence on the chelipedes are distinctive of the present species. The following measurements are taken from the large chelipedes of a specimen measuring 117 mm. in total length:—

Total length	i.	m.	c.	p.	f.
185	20	35	55	40	35
169	18	32	50	40	29

From the above measurements it will be seen that the joints of both chelipedes have about the same relative lengths, but unlike *P. idæ* the carpus is shorter than the propodus and the fingers are relatively longer.

The telson is similar to that of *P. idæ*, the inner sub-terminal spinule on each side projecting beyond the tip of the telson by about half its length; the much shorter outer lateral spinule does not reach the tip.

The carapace is slightly scabrous anteriorly; the rest of the body is merely punctate.

Characters of females.—The rostrum is slightly longer than that of the male; it may extend as far as, or slightly beyond, the distal margin of the antennal squame.

The large chelipedes are punctate, sub-equal, and about two-thirds the length of the body. The tubercles on each side of the finger-ridges are poorly developed or even absent. The middle of the palm is sometimes wider than the extremities, in which case it is wider than the distal portion of the carpus. In a specimen measuring 86 mm. in total length, the joint-measurements are as follows:—

i. 9	m. 10.5	c. 16	p. 10	f. 9.
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The females of the present species may easily be mistaken for those of *P. idæ*, but the rostrum differs from that of the latter species in possessing a moderate proximal convexity. In *P. idæ* the proximal portion is very slightly convex or even almost straight. The upper rostral teeth are also larger and placed further apart than in *P. idæ*.

Characters of the young.—The rostrum is sometimes upturned distally as in *P. idæ*; it may extend a little beyond the distal margin of the antennal squame as in females. The proximal portion of the carpus is extremely slender. The proximal portion of the palm is as wide as the distal portion of the carpus. The palm widens towards its middle, so that its inner surface

appears almost convex. This characteristic persists even in certain large males; it is specially marked in young individuals from Cocanada. The tubercles on each side of the finger ridges, so characteristic of adults, are absent in the young. In a specimen measuring 82 mm. the chelipedes are practically equal, and their joint-measurements are as follows:—

i. 9 m. 10 c. 16 p. 10 f. 9.

With advancing age, the chelipedes become unequal in length, the tubercles on the fingers make their appearance, and the pubescence appears more fully developed.

General remarks.—Nobili has described under the name of *P. alcocki* a freshwater prawn from Pondicherry, of which he was able to examine only a single specimen measuring 57 mm. in total length and obviously immature. In it the tooth-formula is $\frac{9}{4}$; the two upper distal teeth are placed near the tip and two teeth are situated on the carapace. The nature and arrangement of the teeth are the same as in the species just described, but we have not yet met with a specimen showing only 9 upper rostral teeth, although we have examined a considerable number. Nobili's figure of the rostrum shows the upper margin to be straight, while in the present species the proximal portion is generally slightly convex. The large chelipede, a figure of which is also given by Nobili, greatly resembles that of young individuals of our species both in shape and in the relative lengths of the joints. Nobili lays stress on the dilatation of the palm in *P. alcocki*, and certain young individuals from Cocanada which we refer to *P. rudis* agree in this respect.

The following is a comparison of the joint-measurements in one of our young specimens measuring 58 mm., and those recorded by Nobili in his single specimen which measured 57 mm. in total length:—

	i.	m.	c.	p.	f.
Our specimen . .	6	7	10·5	6	5·5
Nobili's specimen		7	12	6·5	7·5

While, therefore, it is not unlikely that Nobili's species was based on a young specimen of the one which we have just described from examples at different stages of growth, it is impossible to decide the matter definitely, because young individuals of many species of *Palaemon* closely resemble one another.

The joint-measurements of the large chelipedes of specimens at various stages of growth are given on page 294.

No.	Locality.	Right or left.	LONG CHELIPPE.					SHORT CHELIPPE.					Total length of body.	Total length of long che- lipede.	Total length of short che- lipede.
			Ischium.	Merus.	Carpus.	Palm.	Finger.	Ischium.	Merus.	Carpus.	Palm.	Finger.			
I	Cocanada ..	R	10	11	17	13.5	13	9	10.5	15	12	11.5	74	64.5	58
II	" ..	L	10.5	14.5	21.5	18	14.5	10	13.5	20	16	14	79	79	73.5
III	" ..	L	10.5	13	20.5	15.5	13	10.5	12.5	19.5	14.5	12.5	83	72.5	69.5
IV	" ..	L	16	28	44	32.5	25.5	13	17	30	20	14.5	92	146	94.5
V	Madras (Olaty)	R	11	13	21	14	13	11	12	19	12.5	11.5	94	72	66
VI	" ..	R	13	20	31.5	21.5	18.5	12.5	18.5	28	18	16	98	104.5	93
VII	" ..	L	12	16	26.5	18.5	16	11.5	15.5	24.5	17	15.5	99	89	84
VIII	" ..	L	12.5	16	24.5	17	14.5	12	14.5	22	14	12.5	101	84.5	75
IX	Madras (Yasarapadi)	L	14	18.5	29	21.5	17	13	10.5	26	17.5	14	102	100	87
X	" ..	R	19	32	52.5	40	31.5	17.5	30	48	35	27	111	175	157.5
XI	" ..	R	20	35	55	40	35	18	32	50	40	29	117	185	169

Localities.—A large number of males and females from Madras; several males from Cocanada.

General distribution.—*P. rudis* has been recorded from Madagascar (Coutière), Mozambique (Hilgendorf), East Africa (Pfeffer), and Ceylon (Heller).

PALAEEMON NOBILII, n. sp.

(Pl. xvii, figs. 6a—e.)

We include in this species two specimens from Walajabad, Chingleput District, a male and a female, the latter bearing eggs, which differ greatly from all the other Indian species which we have examined.

Characters of the male.—The single specimen measuring 64 mm. in total length is well developed and apparently possesses adult characters. The rostrum tapers somewhat abruptly towards the acute tip, and extends slightly in front of the antennular stalk; the dental formula is $\frac{12}{2}$. The part of the upper rostral margin on which the fourth to the tenth teeth are situated is convex, and the apex forms an acute slightly upturned tooth. The first five upper teeth are on the carapace, and of these the first four are separated by wider intervals than the others; the last tooth is placed a little distance from the apex.

The large chelipedes are sub-cylindrical, and unequal, the left one longer than the right. In the former, the palm is slightly compressed dorso-ventrally, and is as wide as the distal end of the carpus; the finger-tips are abruptly incurved. The distal tooth on the mobile finger is a little behind the middle of the joint, and is smaller than the proximal tooth; the tooth on the immobile finger is about the same size as the distal tooth on the mobile finger. The chelipedes are provided with numerous forwardly directed spinules; those on the under surface being fewer but more strongly developed than those on the upper surface. The teeth on the median ridges of the fingers of the short chelipede are weaker, and the opposed margins are provided with more numerous setæ; in other respects the short chelipede is similar to the longer one. The joint-measurements are as follows:—

	Total length	i.	m.	c.	p.	f.
R. chelipede	.. 56	8.5	11	14.5	15	7
L. chelipede	.. 70.75	10.75	13.75	19.5	18.75	8

It should be noticed from the above measurements, that the fingers are shorter than half the length of the palm, and that in the longer chelipede, the carpus is much longer than the merus.

The telson-tip is not so acute as in *P. carcinus* and *P. malcolmsonii*; the inner lateral spinules extend beyond the tip by a little less than half their length; the outer spinules are very short;

the setæ at the tip of the telson exceed the lateral spinules in total length. The body is smooth.

Characters of the female.—It measures 54.5 mm. in total length. The distal portion of the upper margin of the rostrum is almost straight, and extends only as far as the tip of the antennular stalk.

The tooth-formula is $\frac{10}{2}$; the first four upper teeth are on the carapace, while the first three are separated by wider intervals than the others. The large chelipedes are sub-equal, and are very slightly scabrous; the teeth on the immobile finger are absent, while the one on the mobile finger is poorly developed. The joint measurements are as follows:—

	Total length	i.	m.	c.	p.	f.
R. chelipede ..	38.5	7	7.5	10	8	6
L. chelipede ..	41.5	7	8	11	9.5	6

In some respects, this species resembles *P. altijrons*, Henderson, recorded from Delhi, the River Jumna and Lahore, but in the latter the carpus is a little shorter than the merus, and the fingers are more than half the length of the palm and are smooth above and below.

We have associated this species with the name of the Italian naturalist Nobili, by whose untimely death science has been deprived of an indefatigable worker, more particularly in the field of carcinology. While the genus *Palaeomon* was established by Fabricius more than a century ago, from South Indian specimens, Nobili was the first to describe any of these in detail.

P. SCABRICULUS, Heller.

(Pls. xvii, figs. 7a—c, and xviii, figs. 7a—p.)

P. scabriculus, Heller, Verh. Zool.-Botan. Ges. Wien, p. 527 (1862); *Id.*, "Novara" Crust., p. 117, taf. x, fig. 9 (1865); Ortman, Zool. Jahrb. Syst., Bd. v, p. 710 (1891); de Man, in Max Weber's Zool. Ergebn., p. 462, taf. xxvii, fig. 41 (1892); Henderson, Trans. Linn. Soc. Zool. ser. 2, vol. v, p. 442 (1892); Nobili, Boll. Mus. Zool. di Torino, vol. xviii, n. 452, p. 12 (1903).

Characters of adult males.—The rostrum admits of great variation in length and shape; it generally extends as far as the tip of the antennular stalk, but in some cases may fall short of this, while in others it extends slightly beyond; its depth in relation to its length is not very definite. The upper margin of the rostrum also varies considerably in the amount of its convexity; in some examples this margin is practically straight. The tooth-formula is $\frac{12 \text{ to } 15}{2 \text{ to } 3}$, the upper teeth being placed very near each other; the first three or four are wider apart than the others, and the first four or five are on the carapace; thickly-set setæ are present between the teeth.

The large chelipedes are stout and always unequal in length; the longer chelipede which may be either the right or the left is much stouter than the shorter one; they are well provided with long setose hairs. The upper surface of all the joints is roughened by minute close-set spinules, which are best developed on the carpus, while those on the under surface are fewer, but somewhat better developed and more erect; only a few spinules occur on the basis while in the longer chelipede those on the palm are confined to its proximal upper surface. Traversing the dorsal surface of the carpus is a longitudinal groove proceeding from the upper protuberance or knob on the inner side of its distal end; this groove is, however, very faint in some specimens and in a few it is absent. The following are the chief characters of the longer and larger chelipede. The setose hairs on the palm and basal regions of the fingers are matted together to form a velvety covering. The lateral groove on the outer surface of the ischium which is generally present in other freshwater prawns is very faint or even absent here, while that on the inner surface is specially deep. The two inner knobs generally present on the distal end of the carpus are specially prominent in this species, and the groove between them is very deep. The palm is compressed dorso-ventrally; its length in relation to its width varies from about two to one to about three to one; it is wider than the distal end of the carpus. The fingers are of nearly equal thickness; the immobile finger is slightly concave internally and the mobile one has almost the same curve; the tip of the mobile finger is more strongly incurved than that of the immobile one, so that when the fingers are closed it crosses the immobile finger at a short distance from the tip. There is a row of from 17 to 26 tubercles on the median ridge of the mobile finger, and from 12 to 20 on the immobile finger; these tubercles gradually decrease in size towards the distal end; the third or fourth tubercle of the mobile finger is the largest and the basal tooth of the immobile finger fits in behind it. When the fingers are closed their opposed margins do not meet. There is great variation in the relative lengths of the joints; the carpus is generally shorter than the merus, but in some cases it is equal to or even slightly longer than the latter; the palm is longer than the carpus; the fingers are usually much shorter than the palm, but in some cases, they are either equal to it or even slightly longer. The larger chelipede is longer than the body. The smaller chelipede differs from the larger one in the following respects:—The palm is as wide as the distal end of the carpus, and the setose hairs with which it is provided are not matted together. The fingers are equal, and their tips are very slightly incurved; the tubercles on their ridges are poorly developed towards the distal end, and in some cases are totally absent; when closed their margins meet. The palm is generally sub-equal to the carpus, sometimes even shorter; the fingers are always longer than the palm. The shorter chelipedes is shorter than the body.

A table of measurements of the chelipedes in a number of specimens which present adult characters is given on page 299 to show the variation in the relative lengths of the joints.

The tip of the telson is variable; it may be either broadly pointed or rounded. The terminal median spine is short and blunt, and the inner lateral spinules project beyond it by about half or two-thirds of their length; long setæ are present at the tip, and extend much beyond the inner lateral spinules.

The antero-lateral regions of the carapace are scabrous; the walking legs are also scabrous and setose; the setæ present on the free margins of the abdominal epimera and caudal fin are longer than in any of the preceding species.

Characters of females.—The rostrum is usually deeper than in males, and extends beyond the antennular stalk, but not so far as the distal margin of the antennal squame. The large chelipedes are equal or sub-equal, and their length is about half that of the body; they are sparingly setose. The palm is only slightly compressed; the fingers are equal, their median ridges are feebly indented and definite tubercles can scarcely be said to exist. The body is practically smooth. Females with eggs (which are very small in this species) vary from 53 mm. to 40 mm. in total length. In one of them measuring 49 mm. the joint-measurements are as follows :—

i. 5 m. 6 c. 6 p. 5 f. 5.

Characters of the young.—The chelipedes are of equal length in very young males, which shows that with growth one of the chelipedes increases more quickly in length, and assumes the characteristics of the larger chelipede of the adult, while the other grows more slowly. In a specimen measuring 42 mm. in total length, the joint-measurements are as follows :—

i. 4 m. 5 c. 5 p. 5 f. 4.5.

Colours when fresh.—In large males a median pale band runs along the dorsal surface from the tip of the telson to the rostrum; this is continued along the upper half of the rostrum to its tip. On the abdomen this band is incompletely divided by a median discontinuous greyish streak. The fingers of the shorter chelipede, with the exception of the extreme tips, are dark-blue.

The fingers in the female are encircled by two blue bands; the extreme tips are white. The last pair of abdominal appendages are violet above and below, but their outer borders are white.

Localities.—A large series from Madras, Red Hills, and Wala-jabad; Trichinopoly; Palghat; Calicut; and Tanjore District.

General distribution.—*P. scabriculus* is recorded from Ceylon (Heller), Saleyer and Celebes (de Man). It has been previously met with in the following Indian localities :—Kotri on the River Indus (Henderson), and Pondicherry (Nobili).

P. DOLICHODACTYLUS, Hilgendorf.

(Pl. xviii, figs. 8a–b.)

P. dolichodactylus, Hilgendorf, Monatsb. Akad. Wiss. Berlin, p. 840, taf. iv, fig. 18 (1878); Ortman, l.c., p. 731 (1891); Coutière, Ann. Sci. Nat. Zool. t. xii, p. 283 (1901); Nobili, l.c., p. 13 (1903).

Characters of adult males.—The only points of difference that we have been able to discover between this so-called species and the last are as follows:—The carpus of the longer chelipede is usually longer than the merus; the palm is never wider than the distal end of the carpus, and in most cases is of the same width. The fingers are thinner than those of *P. scabriculus* and are much longer than the palm; the velvety covering on the latter joint is continued to the proximal halves of the fingers. The median ridges bear more tubercles than in *P. scabriculus*, 25 to 32 on the mobile finger and 23 to 25 on the immobile; when closed the opposed margins of the fingers meet.

A table of measurements of the large chelipedes in some specimens which appear to be adult is given on page 303.

We have a male prawn from the Nilambur forest, measuring 64 mm. in total length, which seems to connect *P. scabriculus* and *P. dolichodactylus*. The carpus and merus are of equal length, and the palm is a little longer than the fingers. The fingers are subequal and the velvety covering on the palm is continued on them for only one-third of their length; their opposed margins meet when closed. The mobile finger bears 22 tubercles, and the immobile one 17 in addition to the basal tooth. The joint measurements are as follows:—

	i.	m.	c.	p.	m.f.	im.f.
Long chelipede ..	8	15	15	26.5	24.5	25
Short ..	7	10.5	10.5	8	12.5	12.5

This specimen bears considerable resemblance to *P. petersii*, Hilgendorf, from East Africa (Monatsb. Akad. Wiss. Berlin, p. 841, taf. iv, fig. 19, 1878), and we are led to think that *P. petersii* is perhaps only a connecting link between *P. scabriculus* and *P. dolichodactylus*.

Localities.—Many specimens from a river in the Nilambur forest in the Malabar district; an adult male from Palghat; Madras; Walajabad.

General distribution.—*P. dolichodactylus* has been recorded from the East coast of Africa, from Natal to Mozambique (Hilgendorf), Madagascar (Coutière). Nobili records it from Pondicherry.

P. DUBIUS, n. sp.

(Pl. xviii, figs. 9a–d.)

Characters of adult males.—Again in this form we shall content ourselves by merely indicating the points of difference between it

and the two preceding. The chelipedes are much weaker than in *P. scabriculus* and *P. dolichodactylus*, while the longer chelipede is a little shorter than the body. The setose hairs on the chelipedes are short and few; those on the palm and bases of the fingers are comparatively sparse, so that the joints appear almost naked. The spinules on the chelipedes are feebly developed. The carpus is always shorter than the merus. The palm is not so strongly compressed as in *P. scabriculus* and *P. dolichodactylus*, with the result that it is much longer than broad, the proportion being four to one; it is wider than the distal end of the carpus, and much longer than the fingers. The fingers which are equal are considerably thinner and their tips are much less strongly incurved than in the other two species; the tubercles on the fingers are considerably smaller and fewer: there being only from 12 to 18 on the mobile finger and 11 to 15 on the immobile.

The measurements given on page 304 are taken from the large chelipedes of certain individuals which we regard as adult.

It will be seen from the measurements that there is less variation in the joint-lengths of the chelipedes in the present form than in *P. scabriculus* and *P. dolichodactylus*.

We give on page 305 the joint measurements of three specimens which we are unable to satisfactorily assign to one or other form but which appear to connect *P. scabriculus* and *P. dubius*.

Colours when fresh.—In the males of *P. dubius* there is a median dorsal pale band as in *P. scabriculus*. The fingers of the shorter chelipede are doubly banded with blue as in the females of *P. scabriculus*; those of the larger chelipede are dark blue, with the extreme tips almost white.

Localities.—A large series from Walajabad, Saidapet and other localities in the Chingleput District.

Note.—Though we have allowed the last three forms to remain distinct, the following considerations strongly incline us to the view that they may all belong to one and the same species. Adult males of *P. scabriculus* and *P. dolichodactylus* were found living together at Walajabad, Red Hills and Saidapet, and all three forms were obtained from the same tanks at Palghat and Walajabad, while young males obtained along with them were all alike. All the female specimens collected under the same conditions were also identical. Finally we possess specimens which we are forced to regard as connecting links between the three types of male.

ADDENDUM.

Since the previous pages were written we have received from Villivakkani, a village in the neighbourhood of Madras, an addition to our list in the species which de Man, from an examination of Bengal specimens (*Records, Indian Museum*, vol. ii, part 3, p. 222, 1908), has identified as *P. lamarrei*, Milne-Edw. Many of the specimens are females with ova, measuring from 40 mm. to 45 mm. in total length, and the eggs, which are unusually large

for such a small species, measure approximately 1.75 mm. in length and .75 mm. in breadth.

We succeeded in hatching out a number of the eggs, and ascertained that development is direct in *P. lamarrei*, the young prawn entering upon its free life with the full complement of thoracic and abdominal appendages, except the last pair of the latter, and the abdominal appendages are uniramous. A similar abbreviated metamorphosis was long ago observed by Fritz Müller in the case of *P. potiuna* (*Zool. Anzeig.* Jahrg. iii, 1880).

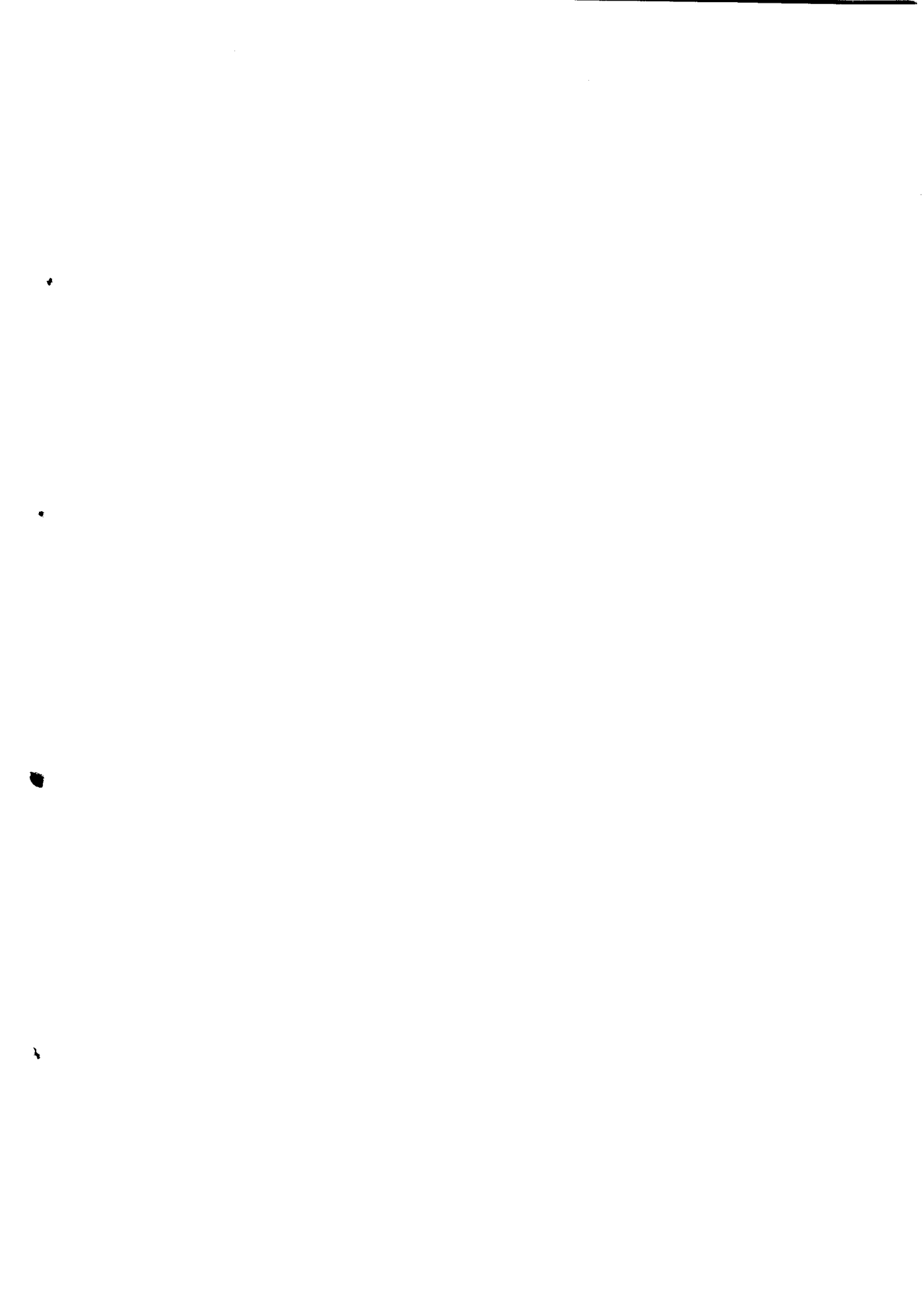
No.	Locality.	LONG CHELIPPE.						SHORT CHELIPPE.				Total length of body.	Total length of long chelipede.	Total length of short chelipede.		
		Right or left.	Ischium.	Merus.	Carpus.	Palm.	Mobile finger.	Immobile finger.	Ischium.	Merus.	Carpus.				Palm.	Finger.
I	Trichinopoly	L	8	13	13	17	18	19	8	10.5	10.5	10	12	61	70	51
II	Madras	L	7.5	14	13.5	20	20	20.75	7	10	9	7.5	10.5	62	75.75	44
III	Walajabad	R	8	6.25	15	26	20.5	20.75	7.5	12	11	10	11.5	66	86	52
IV	Saidapet	R	8	16	14.5	25	20	20.75	7.25	11.5	10	10	11.25	68	84.25	50
V	Trichinopoly	R	8	17	15	25	22.5	24	8	12	11	10	12	71	89	53
VI	Oothucadu (Tanjore Dt.)	L	9.5	19	16	24.5	23.5	24.5	8	13	11.5	11.5	12.5	75	93.5	56.5
VII	Trichinopoly	L	9.5	17	18	26.5	27	28.5	8	12	14	11	16	76	99.5	61
VIII	"	L	10	20	18	30	24	25	9	14.5	13	14.5	15	85	103	66
IX	"	R	11	22.5	19	38	28	30	10	16	14	15	17	88	123	72

No.	Locality.	Right or left.	LONG CHELIPPE.						SHORT CHELIPPE.					Total length of long che- lipede.	Total length of body.	Total length of short chelipede.
			Ischium.	Merus.	Carpus.	Palm.	Mobile finger.	Immobile finger.	Ischium.	Merus.	Carpus.	Palm.	Finger.			
I	River in Nilambur forest, Malabar.	R	8	14	16	16	26	25	7	10.5	11.5	8	13	59	80	50
II	"	R	7	10	11	10.5	17	17	6	7	7.5	6.25	9	60	55.5	35.75
III	"	L	8	15	16.5	18	28	28	7	10	11.5	8.5	14	62	85.5	51
IV	"	L	8	15	17	19	broken	27	7	11	12.5	10	16	67	86	67
V	Walajabad	L	9	17.5	17	22	26	27	7	13	12	13	13.5	71	92.5	58.5
VI	Palghat	L	9	16.5	17.5	23.5	27.5	27.5	8.5	12	14	11	16	73	94	61.5
VII	"	L	10	18	20	21	33.5	35	8.5	14	15	12	17	75	104	66

No.	Locality.	Right or left.	LONG CHELIPPE.					SHORT CHELIPPE.					Total length of long che- lipede.	Total length of body.	Total length of short chelipede.
			Ischium.	Merus.	Carpus.	Palm.	Finger.	Ischium.	Merus.	Carpus.	Palm.	Finger.			
I	Red Hills	.. R	6	10	8.5	13.5	9.5	6	8	7.5	7.5	7.5	62	47.5	36.5
II	Saidapet	.. L	6.5	10	9.5	12.5	10	6.25	8.5	7.75	7.25	8	63	48.5	37.75
III	"	.. L	7	11	11	15.5	12.5	6.5	8.5	8	8	8.5	66	57	39.5
IV	"	.. L	7.25	12	10.25	17.5	11.5	6.5	9	8	8.25	8.5	67	58.5	40.25
V	Walajabad	.. R	7	12	11	17.5	12.5	6.5	9.5	8.5	9	8.5	71	60	42
VI	"	.. L	8	14	12.5	21	15	7	10.5	9.5	10	10	73	70.5	47
VII	Saidapet	.. R	7.5	14.5	13.5	23	15	7.25	10.5	10	9.25	10	75	73.5	47

No.	Locality.	Right or left.	LONG CHELIPPE.					SHORT CHELIPPE.					Total length of long chelipede.	Total length of short chelipede.	
			Ischium.	Merus.	Carpus.	Palm.	Immobile finger.	Ischium.	Merus.	Carpus.	Palm.	Immobile finger.			
I	Madras	R	5	8	7.5	9.5	8.5	5	7	6	5	6	53	38.5	29
II	Palghat	R	6.5	9.5	10	12	11	6.5	8	8.5	7	7.5	61.5	48.5	37.5
III	"	L	7.5	12	12.5	18	15.5	7	9	9.5	8	9.5	70.5	65.5	42.5





EXPLANATION OF PLATE XV.

FIG. 1.—*Palaemon carcinus*, Fabr.

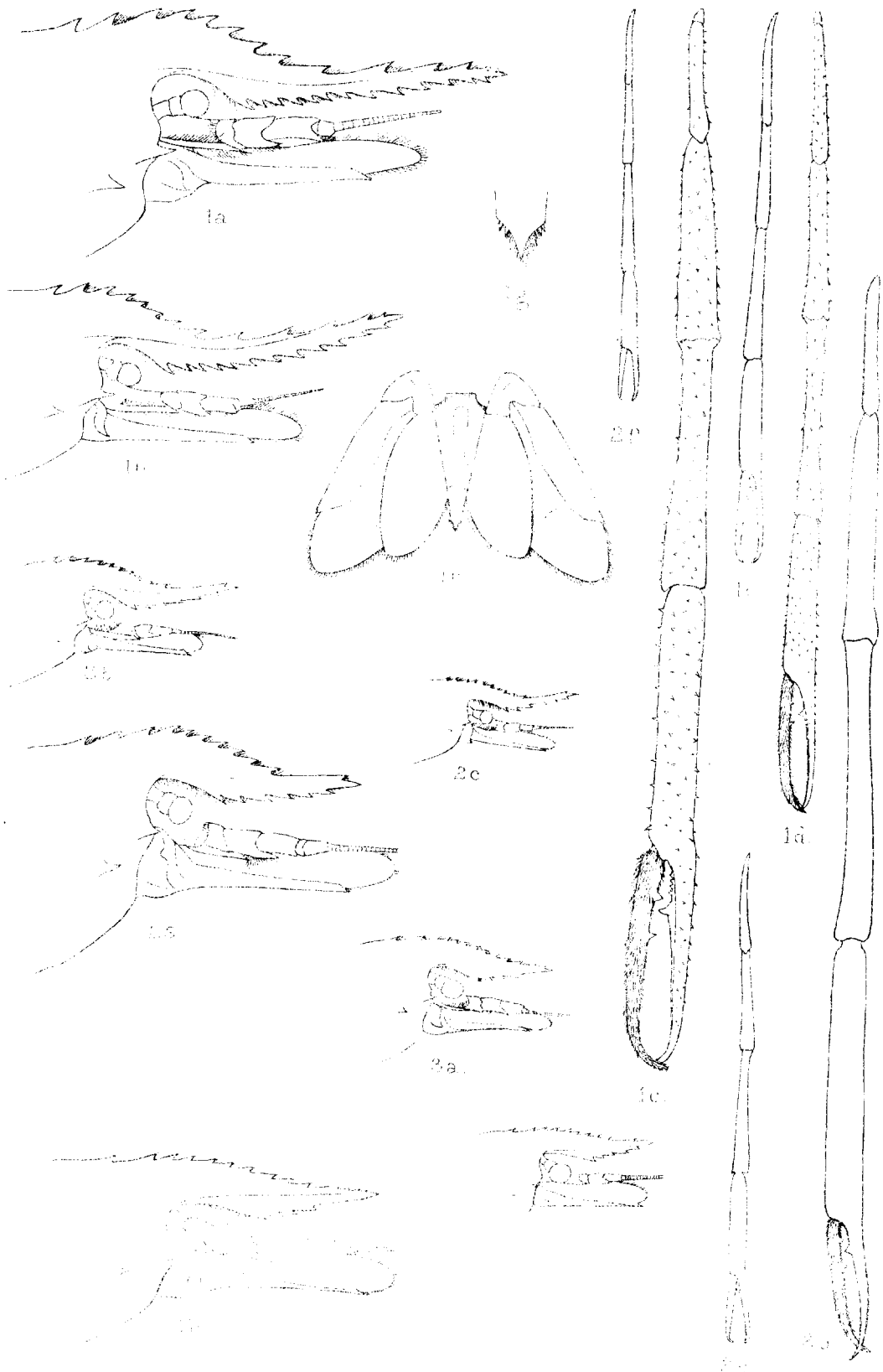
- „ 1a.—Cephalic region, $\frac{3}{4}$ nat. size (σ measuring 295 mm.).
- „ 1b.—Cephalic region, $\frac{3}{4}$ nat. size (φ measuring 232 mm.).
- „ 1c.—Right chelipede, nearly $\frac{3}{8}$ nat. size (σ measuring 295 mm.).
- „ 1d.—Right chelipede, nearly $\frac{3}{4}$ nat. size (φ measuring 232 mm.).
- „ 1e.—Right chelipede of young, nat. size (σ measuring 139 mm.).
- „ 1f.—Caudal fin, nat. size (σ measuring 174 mm.).
- „ 1g.—Apex of telson $\times 3$ (σ measuring 174 mm.).

FIG. 2.—*Palaemon malcolmsonii*, Milne-Edw.

- „ 2a.—Cephalic region, nat. size (σ measuring 191 mm.).
- „ 2b.—Cephalic region, nat. size (φ measuring 118 mm.).
- „ 2c.—Cephalic region, nat. size (σ measuring 87 mm.).
- „ 2d.—Right chelipede, $\frac{1}{2}$ nat. size (σ measuring 191 mm.).
- „ 2e.—Right chelipede, nat. size (φ measuring 118 mm.).
- „ 2f.—Right chelipede, nat. size (σ measuring 86 mm.).

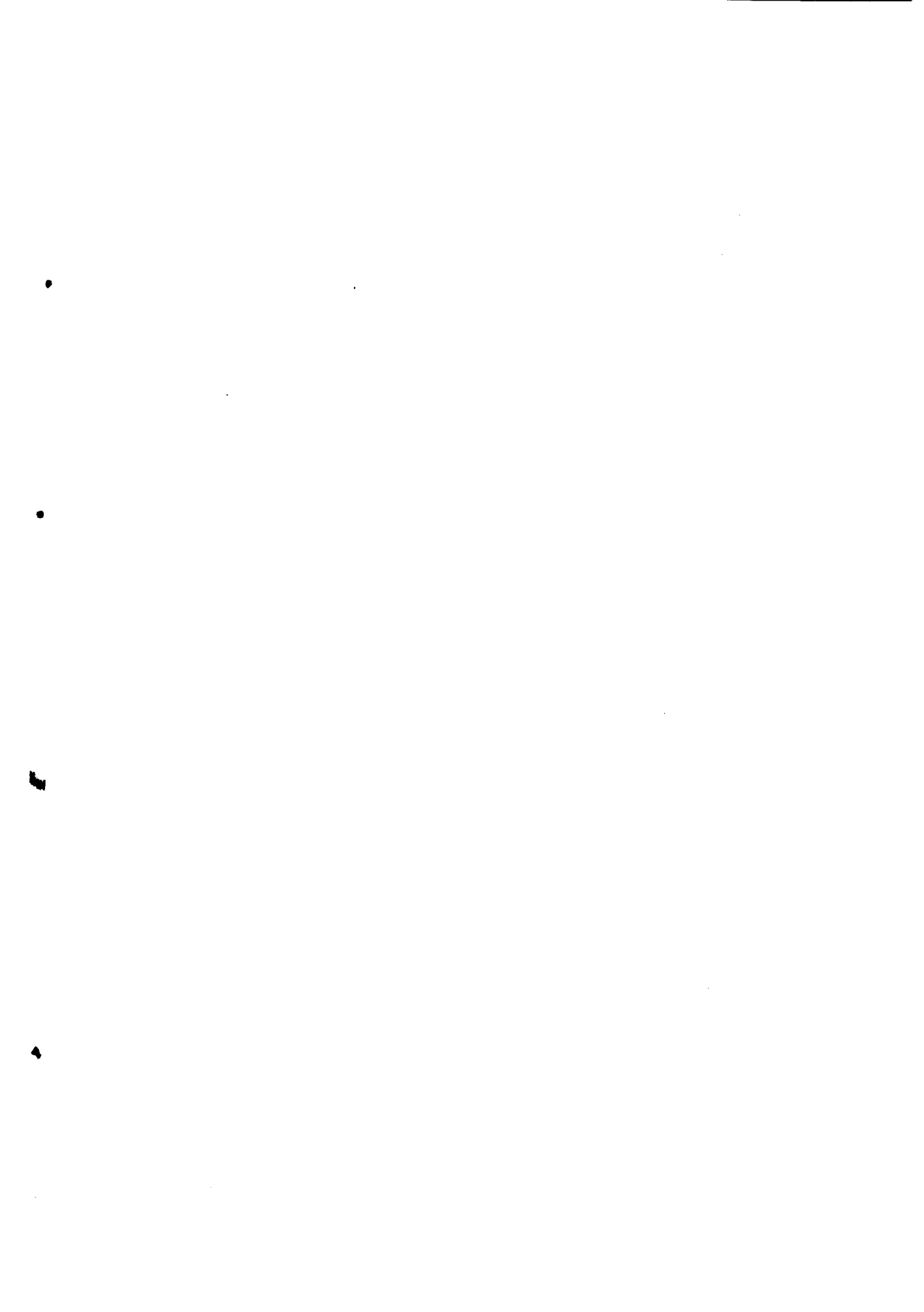
FIG. 3.—*Palaemon idae*, Heller.

- „ 3a.—Cephalic region, nat. size (σ measuring 110 mm.).
- „ 3b.—Cephalic region, with the four terminal upper rostral teeth close together $\times 2$.
- „ 3c.—Cephalic region of φ , nat. size.



1a, 1b, 1c, 1a', 1b', 1c', 2a, 2b, 2c, 3a, 3b, 3c. *Phaenocarpa* sp. n. (1a, 1b, 1c, 1a', 1b', 1c', 2a, 2b, 2c, 3a, 3b, 3c). *Phaenocarpa* sp. n. (1a, 1b, 1c, 1a', 1b', 1c', 2a, 2b, 2c, 3a, 3b, 3c).





EXPLANATION OF PLATE XVI.

FIG. 3.—*Palaemon ida*, Heller.

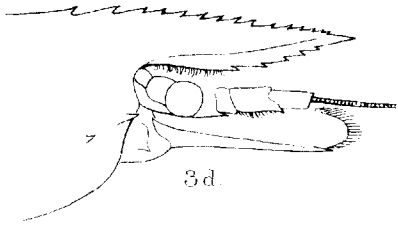
- „ 3*d*.—Cephalic region of ♀ × 2.
- „ 3*c*.—Right chelipede, nat. size (♂ measuring 110 mm.).
- „ 3*f*.—Right chelipede, nat. size (♀ measuring 89 mm.).
- „ 3*g*.—Left chelipede, nat. size (young ♂ measuring 77 mm.).
- „ 3*h*.—Fingers of a Mangalore ♂ to show the teeth × 2.
- „ 3*k*.—Caudal fin, nat. size (♂ measuring 110 mm.).
- „ 3*l*.—Apex of telson × 3 (♂ measuring 110 mm.).

FIG. 4.—*Palaemon sulcatus*, n. sp.

- „ 4*a*.—Cephalic region, nat. size (♂ measuring 93 mm.).
- „ 4*b*.—Cephalic region, nat. size (♂ measuring 82 mm.).
- „ 4*c*.—Cephalic region, nat. size (♂ measuring 82 mm.).
- „ 4*d*.—Cephalic region of ♂, nat. size (measurement lost).
- „ 4*e*.—Right larger chelipede, nat. size (♂ measuring 93 mm.).
- „ 4*f*.—Left short chelipede, nat. size (♂ measuring 93 mm.).
- „ 4*g*.—Left chelipede, nat. size (♀ measuring 71 mm.).



3e.



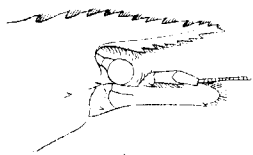
3d.



3f.



3g.



4a.



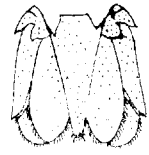
4b.



4c.



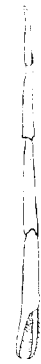
3h.



3k.



3l.



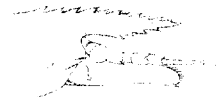
4g.



4h.



4e.



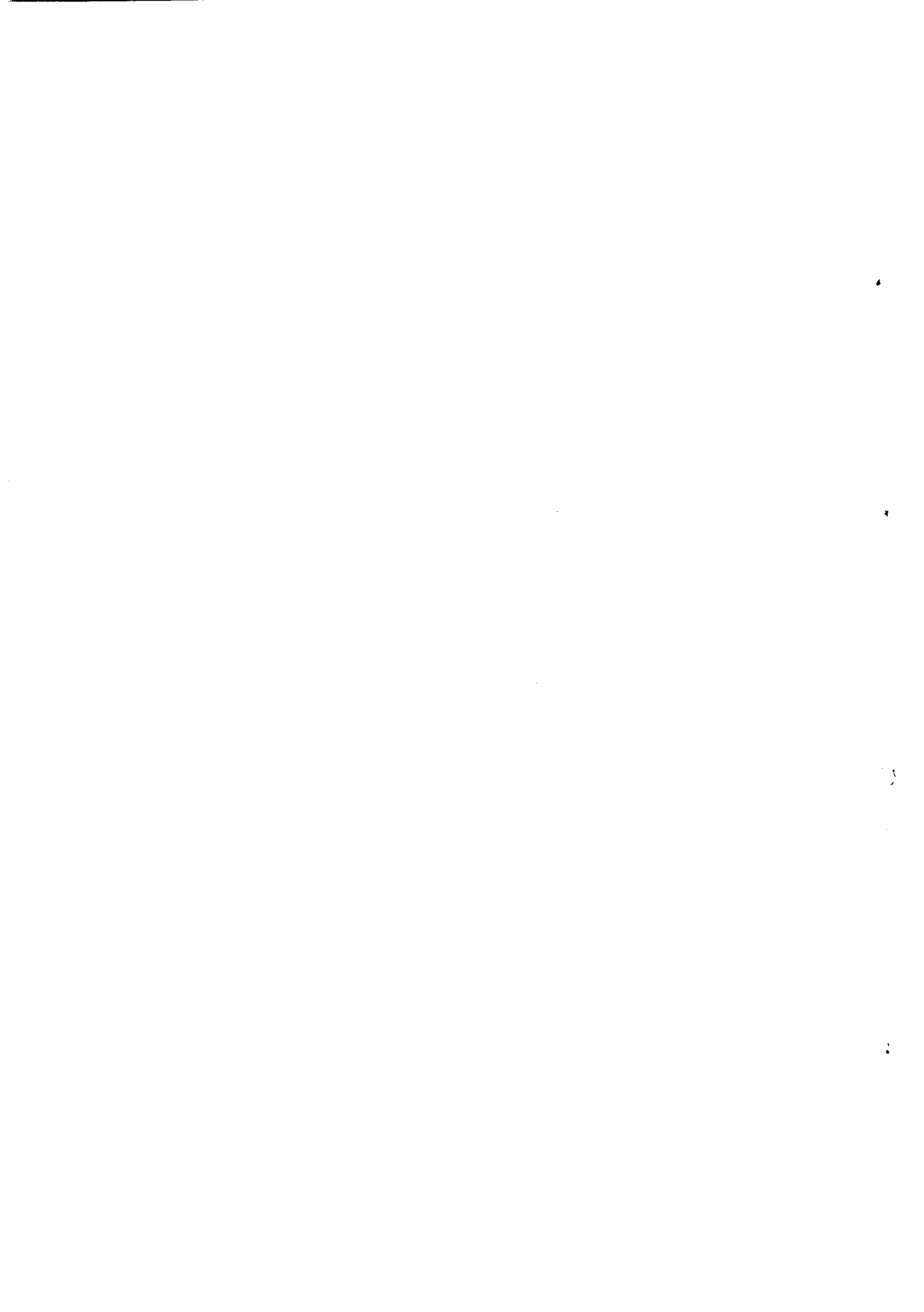
4d.

3d-l. Palaemon (Idae), Heller

4a-g. Palaemon (Idae), Heller

G. M. del.

Coll. Ind. Mus., Ind.



EXPLANATION OF PLATE XVII.

FIG. 5.—*Palaeomon rudis*, Heller.

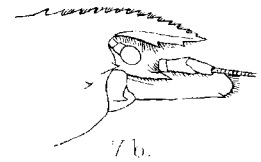
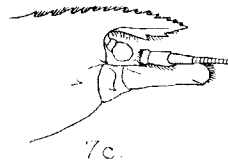
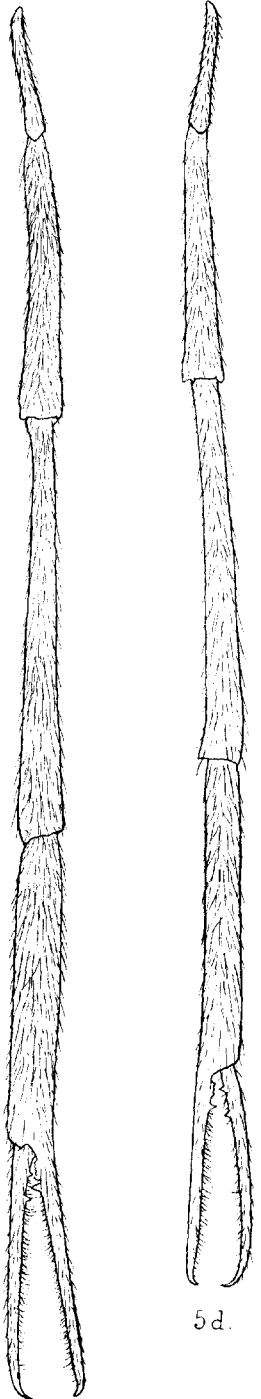
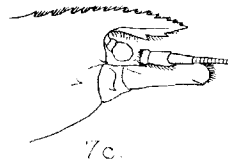
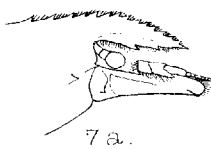
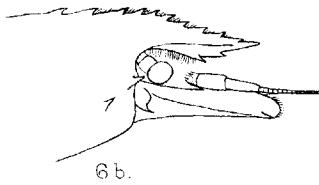
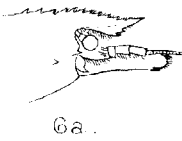
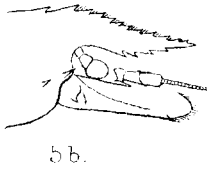
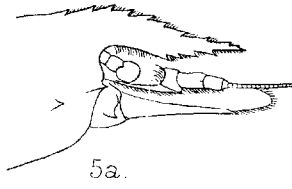
- „ 5a.—Cephalic region, nat. size (♂ measuring 117 mm.).
- „ 5b.—Cephalic region of ♀, nat. size.
- „ 5c.—Right larger chelipede, nat. size (♂ measuring 117 mm.).
- „ 5d.—Left short chelipede, nat. size (♂ measuring 117 mm.).
- „ 5e.—Right chelipede, nat. size (♀ measuring 86 mm.).
- „ 5f.—Regenerated chelipede, nat. size (♂ measuring 105 mm.).
- „ 5g.—Right chelipede showing dilatation of palm, nat. size
(Cocanada ♂ measuring 74 mm.).
- „ 5h.—Apex of telson × 3 (♂ measuring 117 mm.).

FIG. 6.—*Palaeomon nobilii*, n. sp.

- „ 6a.—Cephalic region, nat. size (♂ measuring 64 mm.).
- „ 6b.—Cephalic region, × 2 (♀ measuring 54.5 mm.).
- „ 6c.—Left larger chelipede, nat. size (♂ measuring 64 mm.).
- „ 6d.—Left chelipede, nat. size (♀ measuring 54.5 mm.).
- „ 6e.—Apex of telson × 3 (♂ measuring 64 mm.).

FIG. 7.—*Palaeomon scabriculus*, Heller.

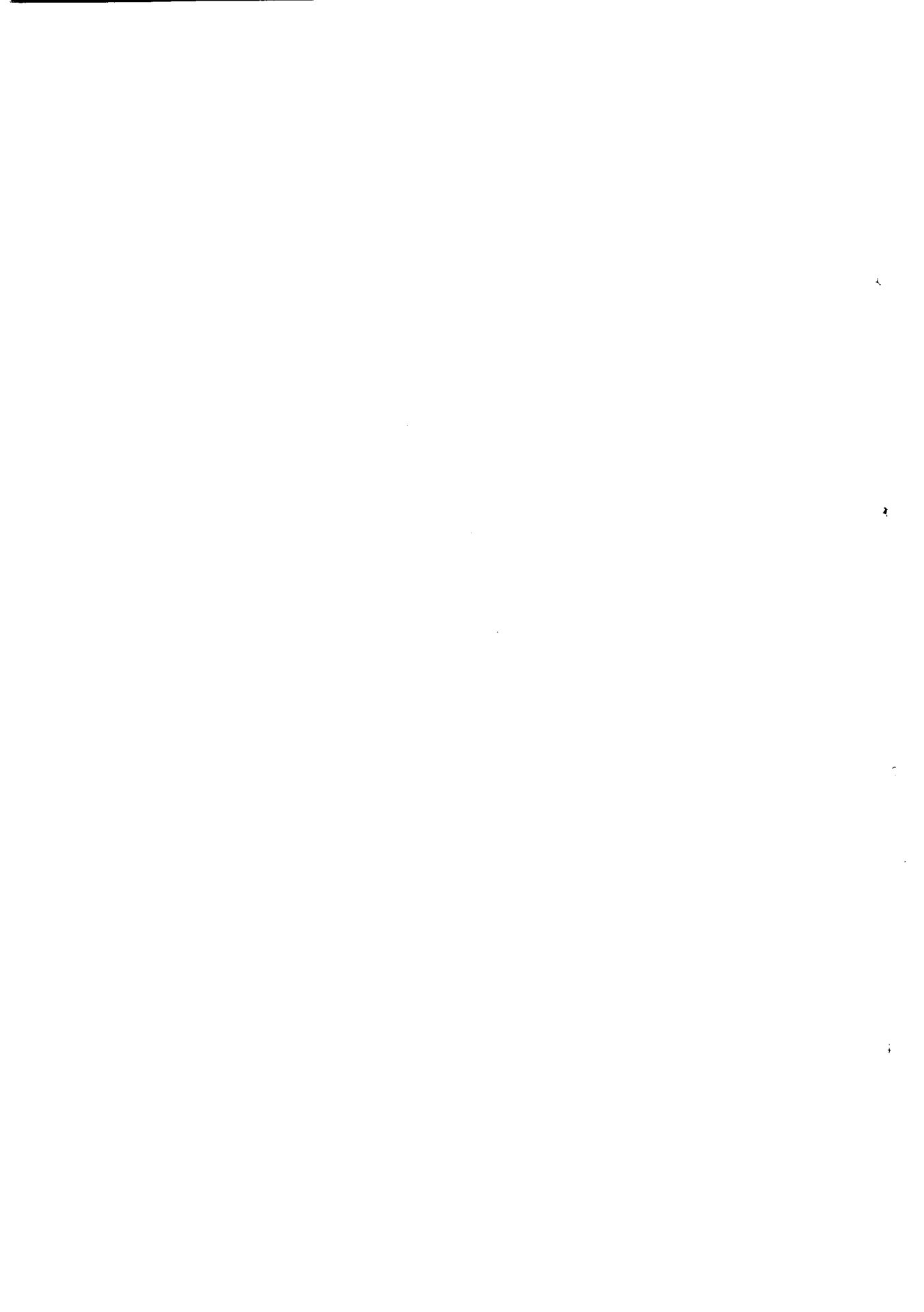
- „ 7a.—Cephalic region of ♂, nat. size
 - „ 7b.—Cephalic region of ♂, nat. size
 - „ 7c.—Cephalic region of ♂, nat. size
- } showing variation in
shape of rostrum.

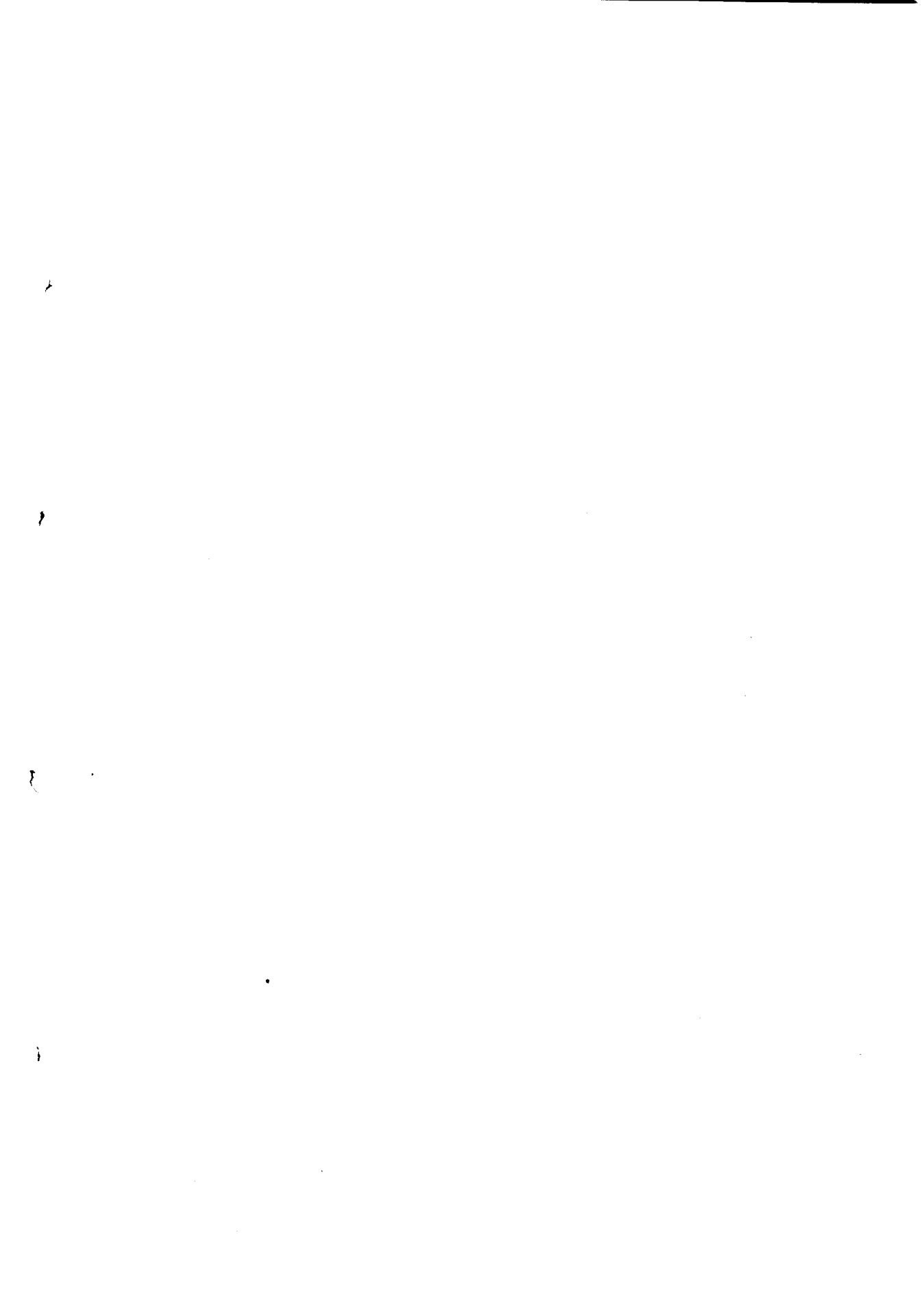


5a-h. *Palaemon rudis*, Heller.

6a-e. *Palaemon nobilii*, nsp.

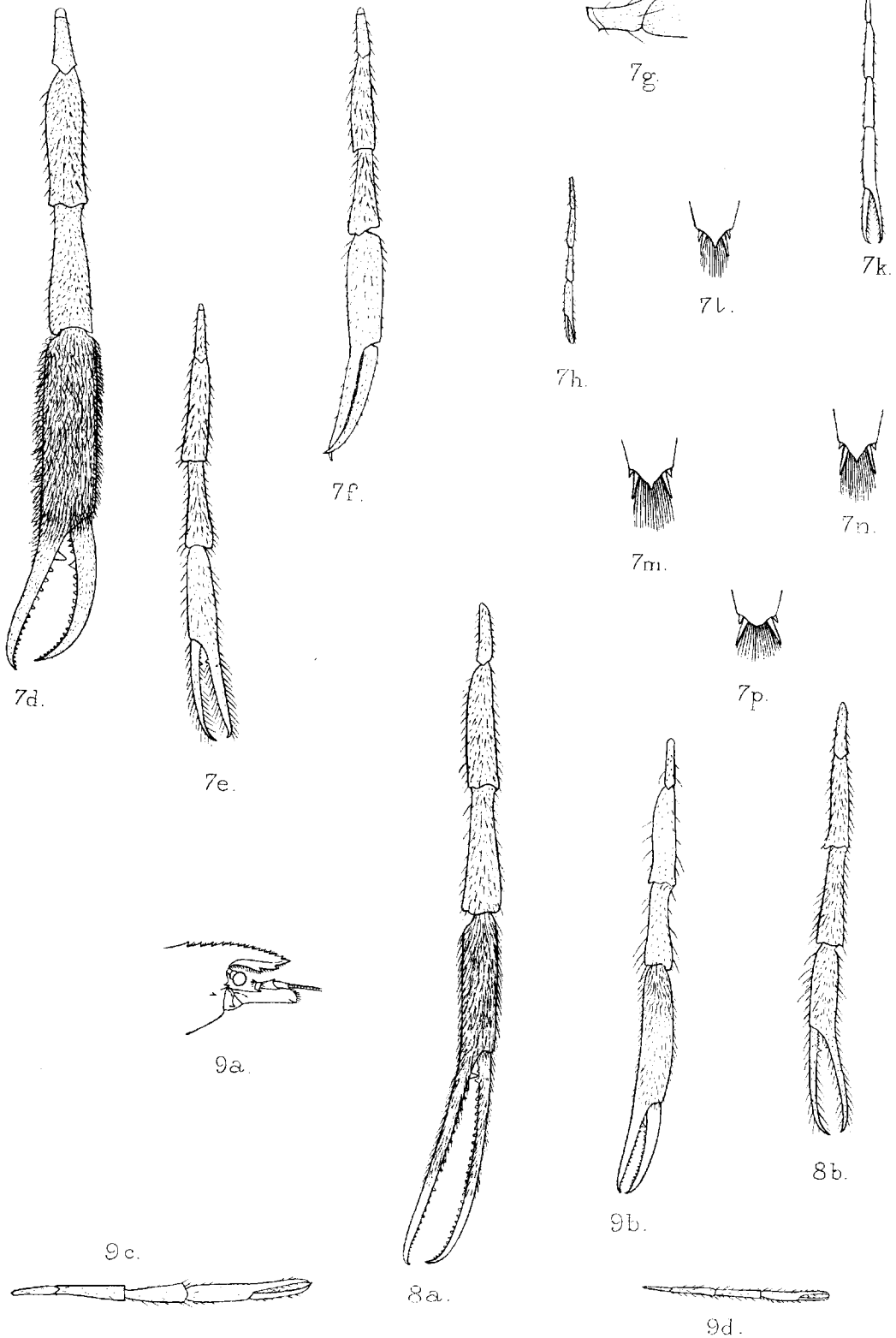
7a-c. *Palaemon scabriculus*, Heller.





EXPLANATION OF PLATE XVIII.

- FIG. 7.—*Palaeomon scabriculus*, Heller.
 „ 7d.—Left larger chelipede of ♂, nat. size.
 „ 7e.—Right short chelipede of ♂, nat. size.
 „ 7f.—Left larger chelipede of ♂, nat. size.
 „ 7g.—Ischium of ♂, nat. size.
 „ 7h.—Right larger chelipede, nat. size (♀ measuring 46 mm.).
 „ 7k.—Right regenerated chelipede, nat. size (♂ measuring 53 mm.).
 „ 7l.—Apex of telson × 3 (♂ measuring 62 mm.) } showing
 „ 7m.—Apex of telson × 3 (♂ measuring 75 mm.) } variation
 „ 7n.—Apex of telson × 3 (♂ measuring 45 mm.) } in telson
 „ 7p.—Apex of telson of ♂ × 3 } tip.
- FIG. 8.—*Palaeomon dolichodactylus*, Hilg.
 „ 8a.—Left larger chelipede, nat. size (♂ measuring 75 mm.).
 „ 8b.—Right short chelipede, nat. size (♂ measuring 75 mm.).
- FIG. 9.—*Palaeomon dubius*, n. sp.
 „ 9a.—Cephalic region, nat. size (♂ measuring 75 mm.).
 „ 9b.—Left larger chelipede, nat. size (♂ measuring 75 mm.).
 „ 9c.—Right short chelipede, nat. size (♂ measuring 75 mm.).
 „ 9d.—Right chelipede, nat. size (♀ measuring 43 mm.).



7d-p. *Palaemon scabriculus*. Heller.

8a-b. *Palaemon dolichodactylus*. Hig.

9a-d. *Palaemon dubius*, n.sp.

G. M. del.

Lith. by, A. C. Chowdhary.

