As described and illustrated by Haentzschel[2,3] present species differs from *Ichnyspica pectinata* Linck in having more cross-markings per cm and also a narrower form.

Along with this trace Gupta *et al* (*op. cit.*) have noticed three roundish tubular structures, through one of which they have visualised a head of 'some worm' protruding out. In fact these are the cross-sections of burrows of the animal that created the trail. Present trail shows obvious continuity upto one of the burrow openings, through which the animal came out and created the trail, while going away from it. This is also evident from the backward inclination of tooth-like projections, which is more clearly seen in the straighter distal portion of the trail.

The associated burrows mentioned by Gupta *et al.* as tubular structures, by their morphology, belong in fact to the ichnogenus *Monocraterion* Torell and perhaps the worm creating it used these burrows only as domichnia. That these burrows had not been drilled in a hard substrate is evident from the disturbed sediment lamellae and slightly depressed area around the burrows. This is possible to happen only in wet sediments. Further endichnial nature of these domichnial burrows is proved as sediment inside and outside them is the same, thus ruling out any possibility of these burrows being chemically drilled structures in a hard substrate.

This specimen with the burrows and a trail preserved in obvious juxtaposition brings into light the unquestionable relationship between the trail *Ichnyspica* Linck and the burrow ichnogenus *Monocraterion* Torell.

FIGS. 1, A–B. Fig. 1 A. *Monocraterion* burrow, ×1. Fig. 1 B. Trail *Ichnyspica guptai*, sp. nov., × 1.

Burrows like *Monocraterion* are created by present day anemone *Cerianthus* according to Schaefer[4], Crimes[5], Bromley *et al.*[6] However, it is difficult to imagine cerianthid animal creating a trail similar to *Ichnyspica* as the morphology of this animal is not suited to that purpose.

The ichnospecies is named after Dr. P. D. Gupta who had collected this specimen and very kindly lent to us for study.

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CHROMOSOME ARCHITECTURE IN THE EARWIG, *PROREUS* SP.

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THE chromosomes of *Proreus* sp., belonging to the family Chelisochidae (Dermaptera), have been described with special reference to its sex mechanism. Its diploid number is 16 with XY-type of sex mechanism in the male.

The chromosomes of Indian earwigs (Dermaptera) have been studied by various workers[1–9] in thirteen different species belonging to the families Diplatyidae, Carcinophoridae, Labiidae, Labiduridae and Forficulidae. However, the family Chelisochidae, which is taxonomically known by eight genera with twenty-two species from India alone[10], has remained neglected cytologically. Therefore, the present studies on *Proreus* sp., belonging to this family, were undertaken with a view to adding more to the existing cytological data and thereby bringing the family Chelisochidae on the cytological record for the first time.

Materials and Methods

Eight male and many female individuals of *Proreus* sp. were procured from Kalka, Nalagarh and their

<div align="center">

TABLE I

Morphometrical analysis of the mitotic chromosomes in Proreus sp.

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Chromosome number	1	2	3	4	5	6	7	X	Y
Length in μm	5·80	5·25	2·80	2·70	2·50	2·45	2·15	3·60	2·40

surrounding areas during the months of May to August, 1973. Their gonads were fixed in acetic-alcohol (1 : 3) for 20–30 minutes after pretreatment in sodium citrate (0·90%) for a similar period. The air-dried chromosomal preparations were made permanent following the procedure laid down by Crozier[11] and stained in Carbol Fuchsin.

Results

All the spermatogonial (Fig. 1) and oogonial (Fig. 3) metaphases studied reveal each 16 chromsomes, 4 of which are larger than the remaining 12. Although some of the chromosomes look like curved rods, there are no constrictions or sharp bends which could account for the localized centromeres. Whereas in the female karyotype (Fig. 4) they form 8 homologous pairs, in the male (Fig. 2) 14 of them constitute 7 homologous pairs and the remaining 2 form a hetero-morphic sex pair comprising X and Y chromosomes which are dissimilar in their size. The X-chromosome occupies the 3rd position in the karyotype and measures 3·60 μm. However, the Y-chromosome is not the smallest in the complement and measures 2·40 μm. Accordingly in the female karyotype the 3rd pair of chromosomes has been designated as the XX pair as it corresponds to the position of the X-chromosome in the male karyotype.

Morphometrical analysis of the various mitotic chromosomes has been presented in Table I.

During male meiosis, every diakinesis (Fig. 5) and metaphase-I (Figs. 6 and 7) carries 8 bivalents, 2 of them being larger than the remaining 6. The sex bivalent is distinguished from the autosomal ones in having a difference in size of its two component elements, X and Y which are in an end-to-end association. The Y-chromosome is negatively hetero-pycnotic in comparison to the X-chromosome.

Metaphase-II plates (Fig. 8) again embody 8 chromosomes each. Amongst them 2 are larger than the remaining 6 chromosomes.

Discussion

There is no previous cytological record about the family Chelisochidae to which the present material belongs. Consequently the chromosomes of this species cannot be compared with those of its conge-
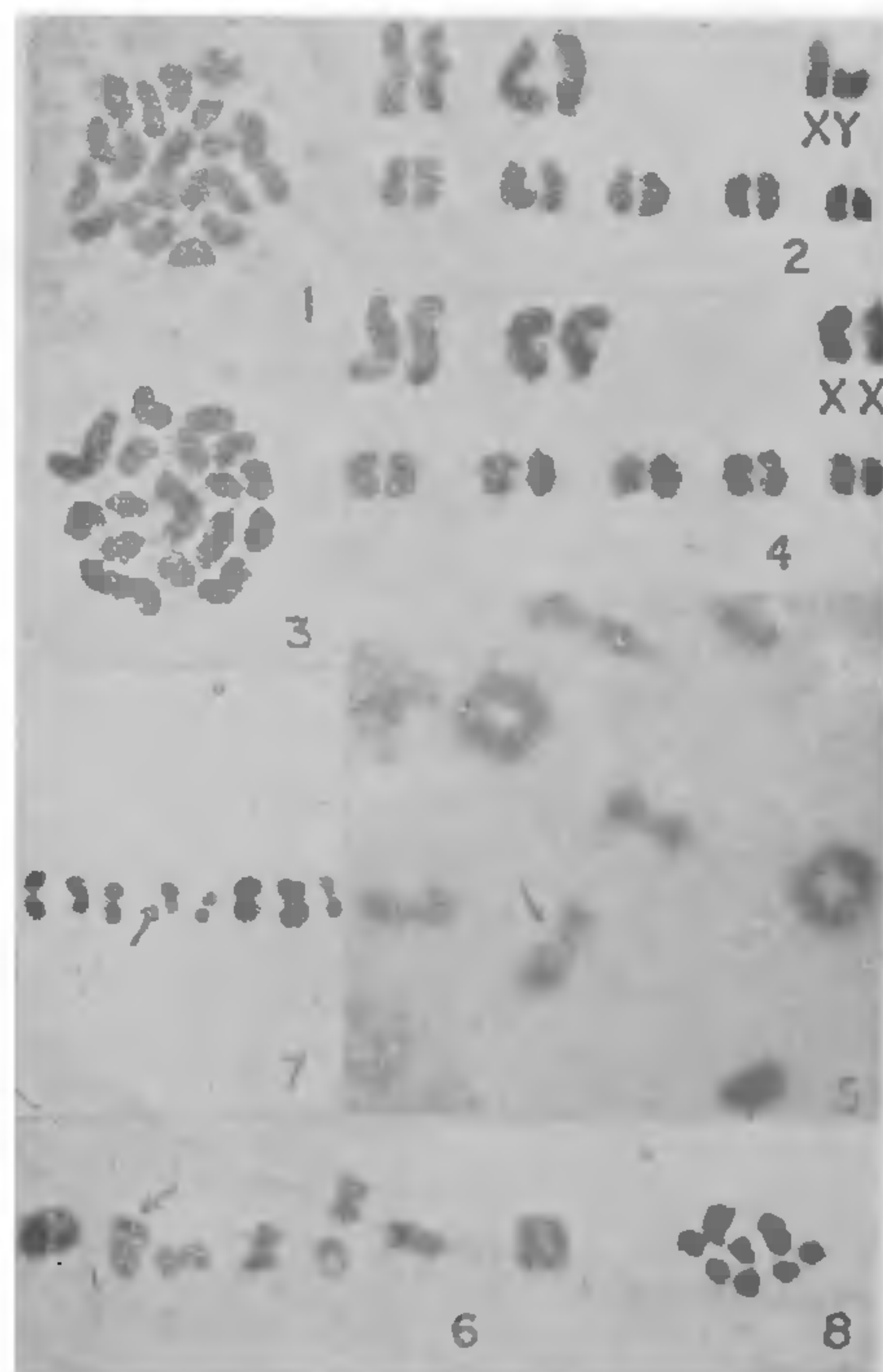
Figs. 1–8. Mitotic and meiotic stages of *Proreus* sp. Fig. 1. Spermatogonial metaphase. Fig. 2. Male karyotype prepared from Fig. 1. Fig. 3. Oogonial metaphase. Fig. 4. Female karyotype prepared from Fig. 3. Fig. 5. Late diakinesis (arrow indicates sex bivalent). Fig. 6. Metaphase-I (arrow indicates sex bivalent). Fig. 7. Metaphase-I with Y-chromosome showing negative heteropycnosis (arrow indicates sex bivalent). Fig. 8. Metaphase-II.

neric or co-familial species. However, this form shows a close resemblance with *Allodahlia macropyga*, belonging to the family Forficulidae in the possession of $2n = 16$ in the male. Both these forms resemble each other in having the male as heterogametic and

they differ in having a different type of sex mechanism. Whereas the present material exhibits an XY-type of male sex-determination like many other dermapterans[1,2,5,6,12-15], *Allodahlia macropyga* reveals an XO-type of sex-determining mechanism.

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ORIGIN OF RETINOL IN FRESHWATER FISH

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THE origin of retinol in mammalian and avian species is well established. Of the several carotenoids β-carotene is considered as the best precursor of retinol and the conversion of β-carotene into retinol takes place in the small intestines (Mitson *et al.*[9], Thomson *et al.*[10], Glover *et al.*[6]). However the picture is not clear in the case of freshwater fish which contain a second form of vitamin A, *viz.*, 3,4-dehydreretinol. We have reported that *Heteropneustes fossilis* can convert lutein (β, ε-carotene-3, 3-diol) into dehydroretinol (Barua *et al.*[1,3]). The fish can further convert 3-hydroxyretinol (Barua *et al.*[4]). When β-carotene is fed to *H. fossilis*, a dehydroretinol predominant fish evidence was obtained of the conversion of β-carotene into retinoic acid and only occasionally into retinol (Barua and Goswami[2]). *H. fossilis* can therefore convert lutein into dehydroretinol either to compensate the toxic effect of large quantities of retinoic acid formed from β-carotene which can support growth (Krishnamurthy *et al.*[7] Malathi *et al.*[8], Zile and Deluca[11]) only or to take active part in vision (Dowling and Wald[5]) and reproduction (Thomspon *et al.*[10]), the two important functions which cannot occur in the absence of retinol.

All the freshwater fishes are not dehydroretinol predominant, some like the mammalian and avian species contain mainly retinol. We therefore, considered that the study of conversion of β-carotene into vitamin A in retinol rich freshwater fish would be interesting. We report here that *Channa gachua*, a retinol rich fish like other mammalian and avian species, can convert β-carotene into retinol.

The sources of solvents, chemicals and other experimental methods like administration of carotenoids, extraction of lipids and chromatography etc. were described in our previous report (Barua and Goswami[2]).

Channa gachua, a retinol predominant freshwater fish (murrel) were acquired from local fish market and were kept in earthenware vessels with perforated lids. The fishes were kept alive and starved for 25-30 days. The intestinal extract of *C. gachua* maintained in starved condition was found free of any detectable amount of vitamin A or carotenoid after 25-30 days. Only those groups of fish which were found free from any vitamin A or carotenoid were used in the metabolism of β-carotene.

The intestines of the starved fish which were found free from carotenoid and vitamin A as judged from the ultraviolet and visible absorption spectra fail to produce any colour with antimony trichloride reagent confirmed that the intestines were free from any vitamin A or carotenoid. Aqueous suspension of β-carotene in Tween-80 (1000 μg/ml) as described by Barua and Goswami[2], was administered. The fish were killed 4-6 hours after the administration of β-carotene. The caroteniods and any vitamin A formed were separated by column chromatography of the intestinal extracts on water deactivated (5%) alumina columns and characterised by their ultraviolet and visible spectra and antimony trichloride blue colour. It was possible to isolate or detect retinyl ester (Table I) in most of the experiments.

In continuation of our previous findings (Barua and Goswami[2]) that *H. fossilis*, a dehydroretinol