A new blind cyprinid fish from Iraq

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Introduction

Trewavas (1955) described a cavernicolous cyprinid, *Typhlogarra widdowsoni,* from a sink-hole near Haditha, Iraq (±34°4′N, 42°24′E). Earlier, A. G. Widdowson had captured examples of *Typhlogarra* from a deeper sink-hole called the Pidgeon Hole (*sic*) (Widdowson 1954) but none of these reached England. On October 21, 1977, Basim M. Al-Azzawi, a fish collector in the Natural History Research Centre, University of Baghdad, visited a sink-hole at the Sheik Hadid shrine near Haditha to collect some specimens of *Typhlogarra.* The significance of this visit is that it revealed two species of cavernicolous cyprinids, *Typhlogarra* and the new species which we have pleasure in naming after Basim Al-Azzawi.

Recently, Greenwood (1976) described a blind, depigmented loach, *Noemacheilus smithi,* which shares its subterranean waters in the Zagros mountains with *Iranocypris typhlops.* Here was the first Asiatic cave system known to support two fully cave-adapted species. The rarity of this event was emphasized by Greenwood (1976) who thought that the Zagros mountain situation was paralleled only by that in the Mammoth Cave, Kentucky. To that very short list we can add only the poorly known Yardee Creek Wells, Northwest Australia where the synbranchid *Anommatophasma candidum* Mees (= *Ophisternon candidum fide* Rosen & Greenwood 1976) and the goby *Milyeringia veritas* Whitley occur (Mees 1962), and now the waters below Haditha.

Caecocypris basimi gen. et sp. nov.

Comments on the generic status of the taxon. Until recently, it was accepted practice to consider a cavernicolous species as generically distinct from its nearest epigean relative. The absence of e.g. eyes and pigment were implicitly regarded to be of more 'taxonomic' importance in determining the rank of the taxon than any similarities that the hypogean species and its relatives may possess. The characin *Anoptichthys jordani* Hubbs & Innes, the cyprinid *Caecobarbus geertsi* Boulenger and the synbranchid *Typhlosynbranchus boueti* Pellegrin demonstrate, by their allocated generic names, the theory behind this approach. Recent reconsiderations of some cavernicolous species on a phylogenetic basis have shown the illogicality of a generic level separation for the hypogean member of an epigean genus. Indeed, Greenwood (1976) wrote in his description of the cavernicolous *Noemacheilus smithi* 'Certainly no useful or phyletic purpose would be served by creating for it (*N. smithi*) a new genus that could only be defined on the basis of such features as eyelessness, depigmentation and other regressional trends associated with cave life....' *Typhlosynbranchus boueti,* mentioned above, has now, on phyletic grounds, been transferred to the epigean genus *Monopterus* by Rosen & Greenwood (1976). *Anoptichthys jordani* and its subterranean congeners, which have been the subjects of many biological studies, have been shown to be interfertile with the epigean *Astyanax mexicanus* and have frequently been called as such although (as far as we are aware) the genus *'Anoptichthys'* has not been formally synonymised with *Astyanax* (see details and bibliography in Mitchell, Russell & Elliott 1977). Roberts and Stewart (1976:304) could find no reason for maintaining a separate genus for the blind, rheophilic spiny eel *Caecomastacembelus brichardi;*

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consequently, they placed *Caecomastacembelus* in the synonymy with *Mastacembelus*. Although the phyletic reasonableness of these nomenclatural changes cannot be denied, they are only practicable when the closest epigean relative of the hypogean species has been detected.

The reason behind our decision to place our new species in its own genus is that we have been unable to discover its relationships below the family level.

HOLOTYPE. The holotype is a mature female, 49 mm SL, BMNH 1979.8.3:1 from a natural well in the Sheik Hadid sink hole, Haditha, Iraq. A further eight specimens 7·9 mm–36 mm SL from the same locality, BMNH 1979.8.3:2–9 are paratypes.

DESCRIPTION. The description is based on nine specimens, 7·9–49 mm SL.

SL	49 mm	36 mm	31 mm	30·5 mm	30 mm	27 mm	24 mm	22 mm	7·9 mm
D	21·4	20·8	16·4	16·4	15·0	?	?	?	11·4
HW	18·3	19·4	19·0	19·8	18·4	20·4	?	?	16·5
HL	30·6	30·6	32·2	30·8	30·0	29·7	?	?	26·2
MW	10·6	11·1	9·8	11·5	8·5	11·1	?	?	7·8
Cpl	13·9	14·0	14·8	15·6	15·0	15·5	?	?	–
S-D	54·0	55·5	51·5	54·0	55·0	53·6	?	?	46·5
Ll	29	28	28	29	31	?	29	30	–
Cpsc	12	12	12	?	12	?	?	?	–
D fin	III 7	III 9	III 7	III 8	III 8	III 8	III 8	III 8	7
C fin	I-9-9-I	I-9-8-I	?	I-10-8-I	?	I-9-8-I	I-9-9-I	?	19
A fin	II 5	II 5	II 5	II 5	II 5	II 5	II 5	II 5	4
V fin	II 6	II 7	I 8	II 7	II 7	II 7	?	II 7	–
P fin	II 13	II 13	I 15	?	I 13	II 14	?	II 13	–
Gr	14	12	13	14	13	?	?	?	?

Unless stated otherwise all measurements are expressed as a percentage of the standard length. The key to the symbols will be found on p. 158.

The body is nearly circular in cross section in the abdominal region but becomes progressively compressed caudad. The head is slightly depressed. The mouth is horse-shoe shaped in ventral view. The gape is oblique (Fig. 1) and it extends as far as the vertical from the middle of the nostrils. The lips are thin and covered with minute, hair-like villi. There are no barbels. At their symphysis, the dentaries are produced into a small knob, but there is no corresponding notch in the upper jaw. The gular region has a padded appearance and lacks the mental disc characteristic of the sympatric *Typhlogarra widdowsoni*.

On the cheek there are five or six approximately vertical rows of inconspicuous pits which resemble the 'pit organs' found in some other cyprinids. The smallest specimen has a number of protuberant structures randomly distributed over the lower parts of the sides of the head. The relationship, if any, between these and the 'pit organs' on the larger specimens is uncertain.

Excluding the smallest fish (see below), and that of 24 mm SL, all the specimens have a small slit marking the position of the eye. The orbit is filled by fat globules bound together with loose connective tissue. The 24 mm specimen lacks the slit. In the only specimen (36 mm SL) in which the orbital region was dissected there was no trace of the eye in the left orbit, but in the right orbit there was a small structure (Fig. 2) which we interpret as a very regressed eye. This consists of a small tough sphere with two strap-like bands running rostrad towards the anterior wall of the orbit. From the posterior part of the sphere there are two thin, thread-like bands which appear to have fastened onto the inter-orbital septum. The two sets of bands are tentatively interpreted as residual eye muscles. Histological examination will be necessary before we can have any confidence in our identification of these structures.

The smallest fish has a vestigial eye visible through the translucent tissue (Fig. 3). There is

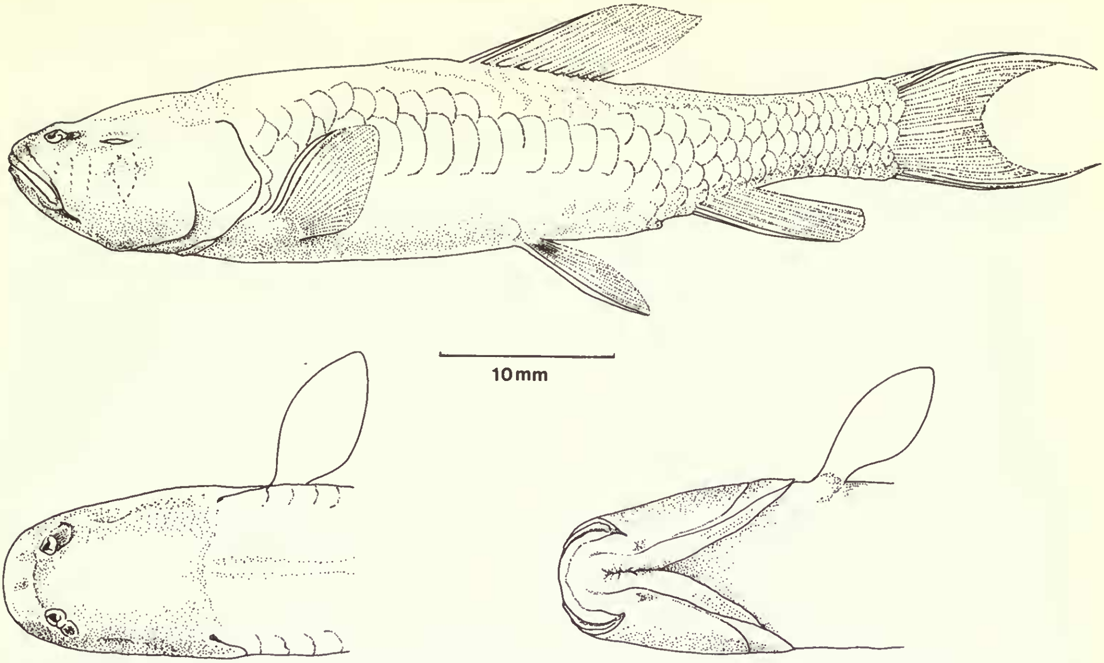

Fig. 1 *Caecocypris basimi* Lateral view (above), dorsal and ventral views of the head (below)

a small spherical lens and faint traces of pigment manifest as pale brown stains forming a ring around, particularly, the dorsal and posterior parts of the lens.

The cephalic lateral line canals are not enlarged. The nostrils are situated at the lateral margin of the flat top of the head almost at the level of the supraorbital bone. The margin of the anterior nostril is produced into a short tube, that of the posterior is flush with the surface of the head. In the specimen of 36 mm SL there are four thick sensory folds on each side of the central nasal lamella.

Fig. 2 Right orbit of the specimen of 36 mm SL.

The isthmus is relatively short and broad, and is not joined to the branchiostegal membrane. This condition is rare in cyprinids and, to the best of our knowledge, does not occur in any other cyprinid in the Tigris and Euphrates system.

The gill rakers are short and slightly curved. The number on the lower limb of the first gill arch is given on p. 152. The position of the fins can be seen in Fig. 1 and the number of rays is given on p. 152. All the simple rays are thin, flexible and smooth. The fins of the smallest example are in the process of differentiating. The pectoral fin is rayless and is carried on a pedicel as is usual in the larval condition. The dorsal fin rays are formed and the fin is separate from the median fin fold. The anal fin is still linked to the median fold and the rays are just beginning to develop.

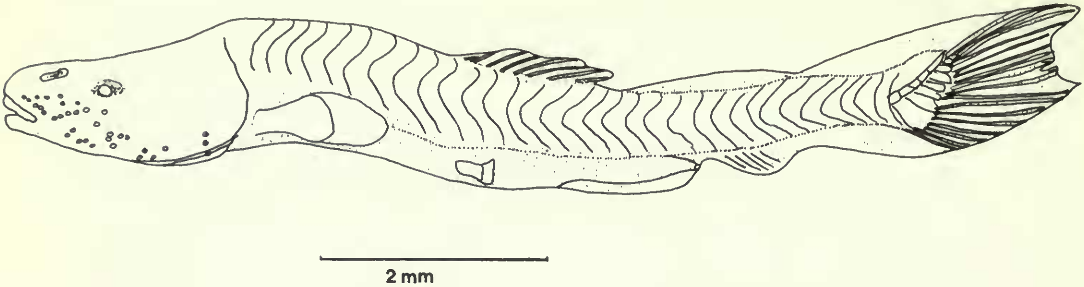

Fig. 3 *Caecocypris basimi* 7·9 mm SL.

In the five specimens radiographed there are 32 vertebrae excluding those comprising the Weberian mechanism and including PU_1+U_1. It is difficult to identify positively the first caudal vertebra from radiographs but there seems to be sixteen or seventeen abdominal vertebrae. Ten pairs of ribs are present. Dorsal and ventral intermuscular bones are poorly ossified and can only be detected posterior to the dorsal fin. The caudal fin skeleton does not appear to differ from the general cyprinid type. The alimentary canal is relatively short with only one major coil and is less than twice the body length. The holotype (a mature female) has over thirty large eggs visible as well as many more less mature ova. The largest eggs are over a millimetre in diameter.

The pharyngeal bones are delicate and bear two rows of slender, conical teeth arranged 5.1–1.5 (f.3). The posterior edentulous process forms a right angle with the rest of the bone.

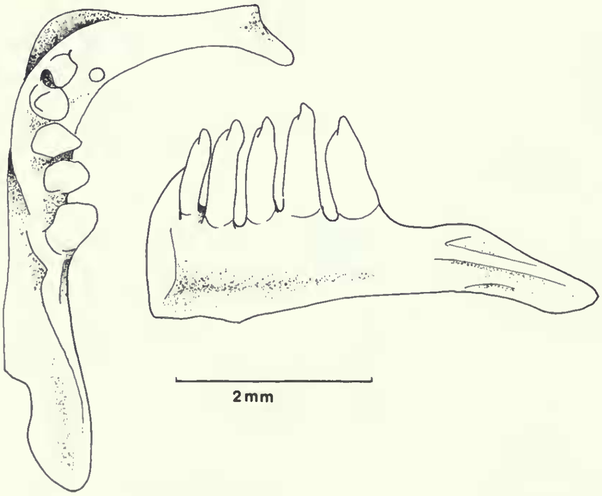

Fig. 4 Left pharyngeal bone of the holotype of *Caecocypris basimi*. Occlusal and ventral aspects.

SQUAMATION. Scales are present only on the larger specimens. A mid-lateral row (corresponding to the lateral line series in other cyprinids, but in this case distinguished by the absence of lateral line tubules) of scales are the best developed, but even they are thin and flexible. Several scales tore during their removal. The biggest fish has a complete mid-lateral row as well as scales over the whole of the caudal peduncle. The back, in front of the dorsal fin, and the abdominal region are scaleless. Above and below the mid-lateral series, in front of the caudal peduncle, there are a few poorly-formed scales. The scales of the mid-lateral series and, to a lesser extent, those on the sides of the caudal peduncle are unusual in that they are deeper than long. The scale striations are more or less parallel (Fig. 5). Scale counts are given on p. 152.

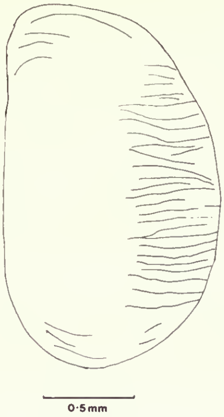

Fig. 5 Scale from the holotype to show the striations.

COLORATION. In life the fish was dead-white suffused with pale pink. The branchial region was deep red, the colour of the blood showing through the translucent tissues. The fins were colourless and there did not appear to be any guanine on the body. Specimens fixed in formalin then preserved in alcohol are an opaque, flat white colour with translucent, pallid fins.

THE LOCALITY. The specimens were collected in a sink-hole near the top of a small hill surmounted by the Sheik Hadid shrine. The hill is some 500 m to the west of the Euphrates on the northern outskirts of the town of Haditha. A few metres to the west of the shrine is a small quarry formerly a source of limestone for building. Access to the sink-hole is via an opening, 2–3 by 6 m, on the floor of the quarry. Below this opening is a cavern, 6 by 6·5 m,

Details of the water analysis from the Sheik Hadid well
Provided by the Department of Chemistry and Minerals, Iraq Foundation General of Minerals

Date 16.6.1979
pH 7·5
Non-Carbonate hardness 23·85 mgl^{-1}
Total dissolved solids @ 22° C 3072 mgl^{-1}

Cations	mgl^{-1}	*Anions*	mgl^{-1}
Na^+	490	Cl^-	912·84
K^+	44·8	SO_4^{--}	1020·64
Ca^{++}	265·53	NO_3^-	nil
Mg^{++}	182·4	NO_2^-	nil
		CO_3^{--}	18·0
		HCO_3^{--}	231·84

its stone-covered floor some 5 m below the quarry floor. At the eastern end of this cavern i.e. the side next to the hill, is natural well with surface dimensions of 1–2 m by 3–4 m and a depth of about 2 m. The water enters the well from four sources, two narrow slits and two oval apertures, about 15–30 cms deep. At the time of collection the greatest depth of water was 63 cms, but in spring the water table rises to fill the well. The well is shaded from direct sunlight by a rock shelf at the eastern edge of the sink-hole opening; only in late afternoon would direct sunlight reach the well.

In all probability, the type locality of *Typhlogarra* (the Haditha hole of Trewavas, 1955) is the sink hole described above. There are no other sink-holes in the area that match the description given by Trewavas (1955). Widdowson's Pidgeon hole is a much deeper sink-hole some 12 km south of Haditha (Widdowson 1954). There are many sink-holes in the area descending to the water table but the Sheik Hadid site differs from all the others in that it has a welling of water to the surface whereas the others are all land collapses of one kind or another. However, the presence of *Typhlogarra* in Widdowson's Pidgeon hole and in the Sheik Hadid well, strongly suggests that the same underground water system is involved. It is not known whether the underground system has any contact with the nearby Euphrates system.

At noon on 13 June 1979 the characteristics of the well water were: temperature 22° C; pH 7·5 and 0_2 content 1·5 mg l^{-1} and salinity 1·75 g l^{-1}. Although a detailed water analysis is provided later, the water may be summarised here as extemely hard, low in oxygen and salinity, and high in sulphates.

NOTES ON THE BIOLOGY. In addition to the two fish species, the underground waters support a yet undescribed species of the blind amphipod *Niphargus*. The stomachs of the post larval specimens of *Caecocypris* were empty but that of the larva contained a small piece of what seemed to be a chitinous material that may have come from an insect larva or a copepod. Dragonfly larvae, copepods, diatoms and green algae occur in the well if not in the completely lightless parts of the system. The blind fish have been seen to enter the well from all four openings and there they swim close to the pebbly bottom of the well. If disturbed they hide among the stones or swim back through the openings. They avoid being in the well when the light is bright and are most abundant at night. It is therefore likely that they are light sensitive to a limited degree.

On the basis of the collections made so far it seems that *Typhlogarra* is about twice as common as *Caecocypris* (68 cf 35). Mr Abdul Hameed Hasan has kindly informed us that the water temperature varies very little during the day or throughout the year, remaining between 21·5 and 22° C. He also observed that specimens less than a centimetre long are always present and concluded that the fishes breed throughout the year.

Both species are remarkably hardy, being able to endure considerable changes in water temperature and chemistry.

DIAGNOSIS. *Caecocypris basimi* can be distinguished from the sympatric *Typhlogarra widdowsoni* by the absence of barbels and mental disc. The former species has a large terminal mouth, the latter a small ventral mouth. *Caecocypris* is unique among cavernicolous cyprinids and middle eastern cyprinids in the possession of a free branchiostegal membrane.

AFFINITIES. In justifying the erection of a new genus for this species we indicated that no close relative could be found. Although *Caecocypris* possesses some undoubted apomorphies they seem to be autapomorphies rather than synapomorphies. As far as we have been able to discover the only other cyprinids with a free branchiostegal membrane are species of the genus *Hypophthalmichthys* from China. *Hypophthalmichthys* is highly derived and specialised for filter feeding (Fang 1928). It is tempting to suppose that the free branchiostegal membrane in *Hypophthalmichthys* is related to its feeding habits. Should that be so, it is unlikely that the free branchiostegal membrane in *Caecocypris* would serve the same function because, a) the species lacks the other modifications associated with filter feeding and b) it is unlikely that a cave system would afford it an adequate planktonic diet. The similar form of the branchiostegal membrane in these two genera therefore can only be interpreted as a parallelism.

The symphysial knob on the lower jaw is a character of mosaic distribution throughout the cyprinids. It occurs in some rasborines, chelines and aspinines (Howes 1978) and, more interestingly, in the cavernicolous, microphthalmic *Barbopsis devecchi* from Somalia. Other resemblance between *Barbopsis* and *Caecocypris* are similar body shape, large mouth, depressed head, similar meristic counts, two rows of pharyngeal teeth and a right-angled bend in the pharyngeal bone. However, the regressional trends associated with a hypogean habitat are not as advanced in *Barbopsis* as they are in *Caecocypris; Barbopsis* is eyed, pigmented, and has four barbels. (It should be noted that the ancestor of *Caecocypris* probably had barbels because the maxillary foramen for the innervation of the anterior barbel is still present although reduced. As far as we are aware, the maxillary foramen is invariably present in the members of that large group of 'barbelled' cyprinids as well as in members of the same group displaying secondary loss of barbels.). The branchiostegal membrane in *Barbopsis* is fused to the short, broad isthmus. We doubt, however, whether these similarities can be used as evidence for a postulated relationship. The body shape, depressed head, large mouth and similar meristics are all of such frequent occurence among the cyprinids as to nullify their use for this purpose. The right-angled bend in the pharyngeal bone could just as well be an obligatory response to similar head shapes as a synapomorphy. We have no precedents, nor evidence, to enable us to argue either case. Two rows of pharyngeal teeth (albeit with different numbers of teeth in the inner row) could indicate: a) reduction from three rows, a regressional trend noticed in other cavernicolous cyprinids e.g. *Caecobarbus* (Thines, 1969) and *Typhlogarra* (personal observation), b) the character was acquired independently or c) a synapomorphy. In view of the fact that so little is known about the polarity of trends associated with pharyngeal teeth we can have no confidence in using the number of rows of teeth to define relationships. Overall, because we cannot find any undoubted synapomophies for *Caecocypris* and *Barbopsis,* it can only be assumed that the similarities are due to parallelism.

No other Asiatic cave fish can be related to *Caecocypris.* Both *Typhlogarra* and *Iranocypris typhlops* are 'garrine' i.e. they have the mental disc, barbels and mouth structure characteristics of their epigean relatives in the genus *Garra.*

A search among the fishes of the Tigris and Euphrates has proved equally fruitless. We cannot find a species that we could postulate as the epigean relative of *Caecocypris.* In a way, this is no surprise. The general conservatism, coupled with the occasional small saltatory morphological changes, in cyprinid characters has the effect of making it difficult, if not impossible, to distinguish between parallelism and the sharing of characters derived through common ancestry. When these problems are overlain by the regressional trends associated with cave life, the likelihood of detecting the relatives of *Caecocypris* diminishes further.

Acknowledgements

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Key to the abbreviations

A fin	Number of rays in the anal fin
C fin	Number of rays in the caudal fin
Cpl	Length of the caudal peduncle
Cpsc	Number of scales round the least circumference of the caudal peduncle
D	Greatest depth of the body
D fin	Number of rays in the dorsal fin
GR	Number of gill rakers on the lower limb of the first gill arch
HL	Head length, from the tip of the snout to the posterior extremity of the opercular bone
HW	Greatest width of the head
Ll	Number of scales in the mid-lateral line
MW	Greatest width of the mouth
P fin	Number of rays in the pectoral fin
S-D	Horizontal between a line perpendicular to the tip of the snout and the origin of the dorsal fin
SL	Standard length
V fin	Number of rays in the ventral fin
–	character absent
?	character unmeasurable or uncountable because of small size or damage.

All distances were measured with dial calipers.

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