

increases of callus. These results are summarized in Table I.

TABLE I  
Growth of callus on WB with different supplements

Medium	Concentration	% Increase	
		Fresh weight*	Dry weight*
WB+ sucrose (control) ..	$10^{-1}$ M	1,360	375
WB+ mannose ..	$10^{-1}$ M	145	28
WB+ 2, 4-D ..	$10^{-5}$ M	1,360	430
WB+ 2, 4, 5-T ..	$10^{-5}$ M	695	185
WB+ SD 8339 ..	$2.5 \times 10^{-5}$ M	1,425	470
WB+ DPU ..	$2.5 \times 10^{-5}$ M	470	140
WB+ YE ..	3,000 ppm	1,425	385

\* Average of 48 cultures; growth period 6 weeks.

Of PAA, 2, 4-D and 2, 4, 5-T, at equimolar concentration of  $10^{-1}$  M, 2, 4-D was most effective.

Of SD 8339, KN, BA, 6- $\gamma$ ,  $\gamma$ ; ZN, AD, TA and DPU, optimal increase of fresh and dry weight occurred with SD 8339, KN and ZN. DPU was least effective.

Recently, the author isolated a white, fragile nodulated callus from the endosperm tissue grown on WB + 2, 4-D + KN + YE. This has been successfully subcultured on WB + CH (1,000 ppm).

Thus, the mature endosperm tissue of *Ricinus communis* can be stimulated to divide and form a continuously-growing callus. All efforts to induce organogenesis in callused endosperm have not yet succeeded, and further studies in this direction are in progress.

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## THE SYSTEMATIC POSITION AND OCCURRENCE OF *PARIOGLOSSUS* (TELEOSTEI : GOBIOIDEA) IN INDIAN WATERS

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THE marine gobioid genus *Parioglossus* Regan 1912<sup>1</sup> (syn. *Herrea* Smith, 1931,<sup>2</sup> not *Herrea* Whitley, 1930,<sup>3</sup> replaced by *Herreolus* Smith, 1931<sup>4</sup>) is of widespread Indo-West Pacific distribution, and comprises four tiny species, the type *P. taeniatus* Regan 1912, originally described from Aldabra,<sup>1</sup> *P. rainfordi* McCulloch, 1921 (Bowen, Queensland<sup>5</sup>), *P. borneensis* Koumans, 1953 (Balikpapan, Borneo<sup>6</sup>), and *P. dotui* Tomiyama, 1958 (SW Japan<sup>7</sup>), the last reaching the maximum size of 37 mm<sup>8</sup> recorded for the genus. *Parioglossus* has been reviewed by Tomiyama,<sup>9</sup> who provides a key and illustrations of these species.

Because of its separate pelvic fins, *Parioglossus* has been placed in the family Eleotridae of the suborder Gobioidea (Regan,<sup>10</sup> Koumans<sup>6</sup>), whose largest family, the Gobiidae, is traditionally characterised by the possession of a shallow ventral disc formed by fusion of the pelvic fins. Although a classification of gobioid fishes based on their osteology was proposed many years ago by Regan,<sup>10</sup> and has been subsequently amplified (Gosline,<sup>11</sup> Hoese<sup>12</sup>), most representatives of the suborder await comprehensive skeletal investigation and, consequently, in several important monographs, have been arranged by external features (Herre,<sup>13</sup> Koumans,<sup>6-14</sup> Smith,<sup>15</sup> etc.).

Recently, the present author has examined alizarin preparations (Fig. 1) and radiographs of the skeleton in *Parioglossus*. While certainly gobioid, with unossified suspensorial foramen (bounded by symplectic, quadrate, and preopercular), and upper (epaxial) and lower (hypaxial) caudal radials, the genus was found however to be gobiid rather than eleotrid in structure. Typical gobiid features displayed are the single pterygoid element in the palatoquadrate arch, markedly T-shaped palatine head, reduced hypercoracoid, five branchiostegous rays, and only one epural plate in the caudal skeleton. *Parioglossus* may thus be regarded as a gobiid specialised externally by secondary separation of the pelvic disc (a trend recorded in many others of the same family<sup>16</sup>) and with further modifications, such as incipient duplication of interspinous bones between neural and haemal spines, forward shifting of the jaw articulation by suspensorial elongation, etc., probably connected with its nektonic mode of life.<sup>17-18</sup> In all the latter features, *Parioglossus* shows affinity with *Ptereleotris* Gill, 1863, *Oxymetopon* Bleeker, 1861, *Ioglossus* Bean, 1882, and probably other genera, all larger free-swimming or burrow-dwelling gobiids with divided pelvic fins.<sup>12-18 19</sup> Another clue to relationships is afforded by the



cephalic lateral-line canal system in *Parioglossus*, which is unusual among gobiids in possessing a separate interorbital canal on each side, with five (including two terminal) pores. These features, together with general habitus, meristic features and behaviour, all resemble those of the very recently described *Vomerogobius flavus* Gilbert, of tropical western Atlantic (Bahamas) occurrence.<sup>20</sup> The latter still shows union of the pelvic fins, although lacking an anterior pelvic membrane, and, at least in adult males, has vomerine teeth, which could not be detected in *Parioglossus*.

Among material studied were many *Parioglossus* from Ratnagiri (Maharashtra, India) and now deposited in the British Museum (Natural History), Reg. No. 1960.12.30.32-61. These examples belong to the same species as that recorded from Ratnagiri by Ranade and Sankolli<sup>21</sup> under the name of *P. taeniatus*, but agree exactly with Tomiyama's description of *P. dotui*, and their dissimilarity with the true *P. taeniatus* has been confirmed by examination of the type specimens of the latter [BM(NH) 1912.5.3.28-29]. Although somewhat faded, the colour pattern of these two types closely resembles that shown by Tomiyama for *P. taeniatus*. According to this author, *P. taeniatus* and *P. dotui* differ from the other pair of species in the possession of a dermal ridge along the dorsal midline of the nape and of contiguous dorsal fins. To identify these two species, *P. taeniatus* has a radial formula of  $D_2$  I/13-14, A I/13-14; about 90 scales in lateral series; markedly convex caudal fin; and dark longitudinal bands on back, sides, and abdomen, with the upper and lateral ones continued on to the caudal fin (Tomiyama,<sup>9</sup> Fig. 3), while *P. dotui* is distinguished by  $D_2$  I/15-18, A I/15-19; about 100 lateral scales; truncate caudal fin; and only dorsal and lateral bands, the latter forming a single short horizontal caudal mark along the proximal lateral midline of this fin (Tomiyama,<sup>9</sup> Fig. 4). In fact, the Ratnagiri *P. dotui* have radial formulae of  $D_2$  I/16-17, A I/16-17 (counting the terminal bifid ray as one in both fins) while the two syntypes of *P. taeniatus* have radial formulae of  $D_2$  I/16, A I/15 and  $D_2$  I/15, A I/16, and well separated dorsal fins, so that these criteria have less value for species definition than Tomiyama supposed. The possibility must be borne in mind that all four nominal species may be colour phases of a single species, perhaps linked with sexual dimorphism in nuchal ridge and dorsal fin deve-

lopment. However, Dotu<sup>8</sup> found ripe adults of both sexes with the livery of *P. dotui* (as *P. taeniatus*; Dotu, Fig. 1), the males showing a dark anal fin.

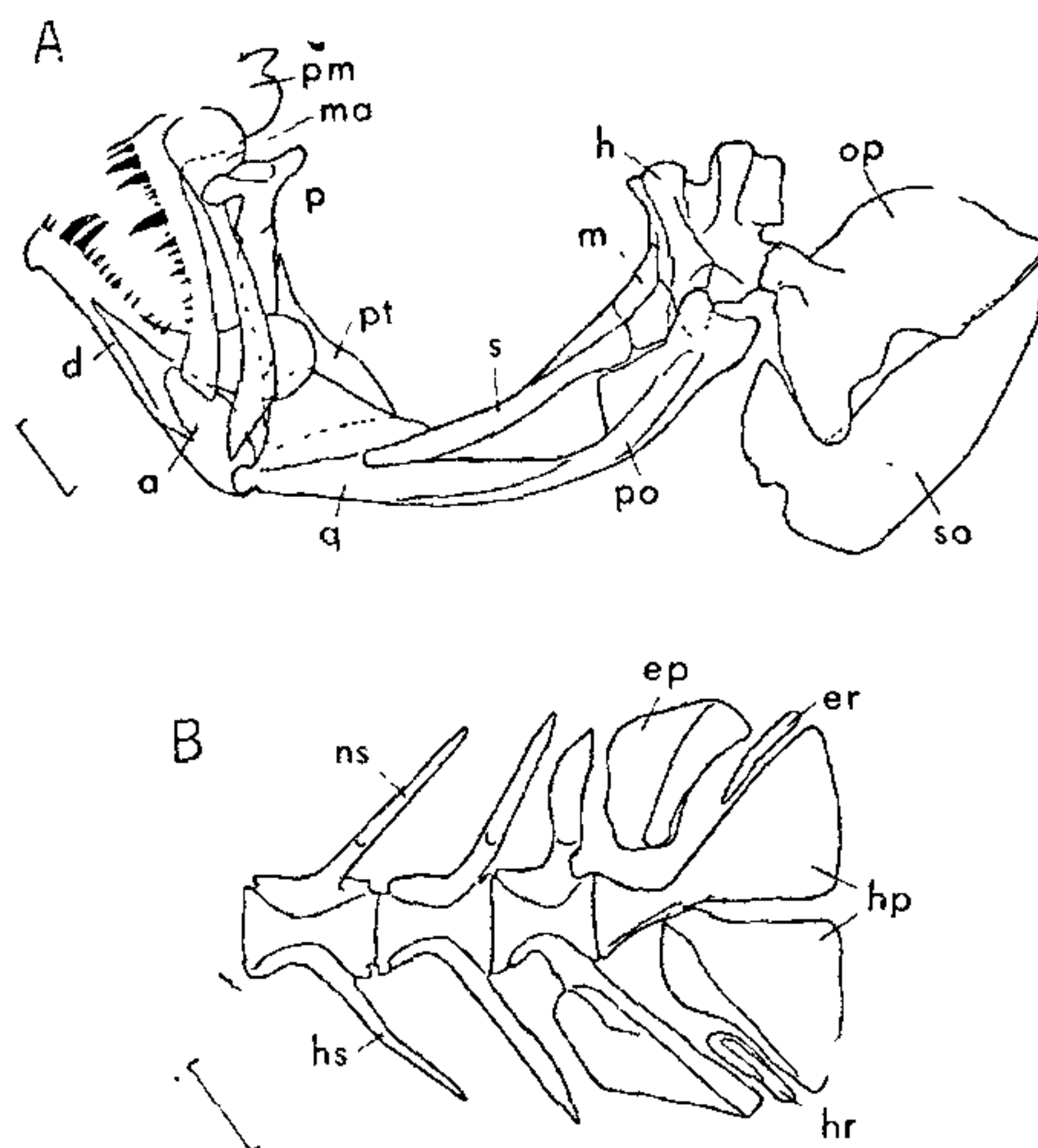


FIG. 1. Suspensorium and jaws (A), and caudal skeleton (B), in *Parioglossus dotui*, 27.5+5.0 and 24.5+4.5 mm respectively BMNH 1960.12.30. 32-61, part) from Ratnagiri, India. Abbreviations: *a*, articular; *d*, dentary; *ep*, epural plate; *er*, epaxial radial; *h*, hyomandibular; *hp*, hypurals; *hr*, hypaxial radial; *hs*, haemal spine; *m*, meta-terygoid; *ma*, maxilla; *ns*, neural spine; *op*, opercular; *p*, palatine; *pm*, premaxilla; *po*, preopercular; *pt*, pterygoid; *q*, quadrate; *s*, symplectic; *so*, subopercular. Scale 0.5 mm.

Ranade and Sankolli<sup>20</sup> described the vivid life colouration of *P. dotui* (as *P. taeniatus*) and found the species 'common in the rock pools of brackish-water regions' of the Ratnagiri coast. The biology, including embryology and postlarval development, of this species (again as *P. taeniatus*) around the Japanese islands of Kyushu and Shikoku has been investigated by Dotu.<sup>8</sup> There, *P. dotui* is a gregarious inshore species, neritic at least during the day, and feeds on planktonic copepods. Breeding takes place from the beginning of July to September (Amakusa Islands, Kyushu). In the case of *P. taeniatus*, the original specimens were collected in the lagoon of Aldabra but, subsequently, intertidal occurrence is reported in the Gulf of Siam (as *Herrea formosa* Smith)<sup>2</sup> and the Philippines (as *Herreolus formosus*),<sup>22</sup> where, at Port Holland (Basilan), Herre observed that a shoal would swim at the surface until disturbed and



then seek refuge in the fouling growth on a nearby piling. Since the area of distribution for *P. dotui* and *P. taeniatus*, is now known to be so extensive, it seems very likely that the latter, and other species of *Parioglossus*, will be recorded from Indian localities.

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## ROTATIONAL ANALYSIS OF THE $C_2$ SYSTEM OF $SbF$ MOLECULE

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THE emission spectrum of  $SbF$  molecule as investigated by earlier workers<sup>1-5</sup> is known to consist of three visible systems ( $A_1$ ,  $A_2$  and  $A_3$ ) and four ultraviolet systems ( $B$ ,  $C_1$ ,  $C_2$  and  $C_3$ ). Patel and Abraham<sup>4</sup> have carried out detailed vibrational analysis of the  $C_2$  and  $C_3$  systems and concluded that both of these systems originate from a close lying upper triplet state. The vibrational frequencies of the two lowest known electronic states of this molecule are 609.0 and 612.6  $cm^{-1}$ . The rotational analyses of the  $C_1$  and  $C_3$  band systems have been reported by Sivaji and Rao<sup>5</sup> and Patel and Abraham<sup>6</sup> respectively. However, the transition involved in the  $C_2$  band system has not been confirmed so far from a study of rotational analysis.

The (0, 0) and (0, 1) bands of the  $C_2$  system excited in a quartz hollow cathode discharge tube have been recorded in the third order of a 35 ft concave grating spectrograph having a dispersion of 0.22 Å/mm. With a slit-width of 50 microns, an exposure of 10 hours was found sufficient to photograph the bands on Ilford Q-2 plates.

Examination of the (0, 0) band of the  $C_2$  system (reproduced in Fig. 1) reveals the presence of three heads of which two are strong and the third is weak. If we treat the two strong heads as P and Q heads of the same band, we should expect for violet degraded

bands the separation between these to be larger for the (0, 0) band than for the (0, 1) band. However, our measurements show this separation to be 3.45  $cm^{-1}$  for the (0, 0) band and 3.65  $cm^{-1}$  for the (0, 1) band. Furthermore, toward the shorter wavelength side of each strong head, there are two regions which give the appearance of band origins. This observation prompted us to treat the two strong heads as belonging to two sub-bands of the same band system. Since the bands are violet-degraded these heads are taken to be corresponding P heads of the two sub-bands. The Q head of the first sub-band appears to merge with the P head of the second sub-band or to be lying very close to it, whereas the Q head of the second sub-band lies very near to the origin of this component. In the second sub-band, there are two intense branches running almost parallel to each other up to high J values, which may be treated as Q and R branches. Also, a series of weak lines has been picked out as a head forming P branch. In addition, the rotational structure corresponding to the first sub-band dies out so rapidly after the head formation that no structure is observed for this component. These features indicate that this band system may originate from a close multiplet upper state. In the second sub-band lying on the shorter wavelength side of the first sub-band, P, Q and R branches have