# BREVIORA

## Museum of Comparative Zoology

CAMBRIDGE, MASS. 24 NOVEMBER, 1967 NUMBER 277


# *LESTIDIUM BIGELOWI*, A NEW SPECIES OF PARALEPIDID FISH WITH PHOTOPHORES


Michael J. F. Graae[1]



## ABSTRACT

Two specimens of a new luminous paralepidid fish were taken in the Indian Ocean during Cruise VI of the R/V *Anton Bruun*. Their main distinguishing feature is the presence of three separate and distinct, circular photophores along the ventral midline that are unlike the light organs found in other paralepidids. The two specimens are described here as a new species, and the structure of one photophore is examined in detail.


## INTRODUCTION

Two evolutionary lineages, the myctophoids and the alepisauroids, are generally recognized within the pelagic members of the Myctophiformes (Iniomi). The myctophoid families Myctophidae and Neoscopelidae have discrete photophores lying in rows on each side of the ventral midline, and it has been shown recently (Haneda, 1958; Rofen, 1965) that a few members of the alepisauroid family Paralepididae have elongated luminous glands immediately on, or adjacent to, the ventral midline. One genus also has a small finger-like projection, before the eye, that may be luminous, but this organ does not appear to have the structure found in the myctophoids. This paper is concerned with a unique new species of paralepidid which, though quite similar to other paralepidids in most characters, is distinguished from them by the discrete photophores on the ventral midline.


[1] 1702 San Andres St., Santa Barbara, California.

I am indebted to the National Science Foundation for its organization of the American Program in Biology, International Indian Ocean Expedition, and to Dr. John H. Ryther of the Woods Hole Oceanographic Institution, the Scientific Director of the program. I also gratefully acknowledge the support of NSF Grant GF-147 to Harvard University, which aided this study. I thank Dr. Giles W. Mead, Chief Scientist during Cruise VI of the *Bruun,* for his counsel during the course of this study and for his review of the manuscript. I am especially indebted to William O'Day, who so kindly and patiently prepared, sectioned, and photographed the photophore described herein. I also wish to extend my appreciation to those who have helped me with advice and encouragement, especially Dr. Basil Nafpaktitis and Mrs. Myvanwy M. Dick. This work is part of a Harvard senior honors dissertation presented in April of 1966.

## LESTIDIUM BIGELOWI, new species

*Holotype:* MCZ 44881, 37.2 mm in standard length; collected during the International Indian Ocean Expedition, R/V *Anton Bruun,* Cruise VI, trawl 339A; APB label 7227; hydrographic station 339; collected in 10′ Isaacs-Kidd Midwater Trawl, depth 0-615m; 30-V-64. 0140-0645 hrs; 4°01′-4°14′S, 65°00′-65°02′E.

*Paratype:* MCZ 44880, 28.4mm in standard length; R/V *Anton Bruun,* Cruise VI; trawl 340B; APB label 7241; hydrographic station 340; 10′ IKMT, 0-746m; 31-V-64, 1945-0155 hrs; 5°55′-6°08′S, 64°48′-64°58′E.

*Diagnosis*: This species is the only paralepidid known to have light organs that are small and discrete, as opposed to long and tubular. There are three of these; all are directed ventrally. One is at the isthmus, one is between the bases of the pectoral fins, and one is just posterior to the bases of the ventral fins. In most characters, *Lestidium bigelowi* is almost intermediate between the genera *Lestidium* and *Lestidiops* (see Table 1).

*Description:* The following description is based on both types. Body long and slender, very compressed. Keel present for short distance ventrally between anus and anal fin. Anus between tips of appressed ventral fins. Skin smooth; scales absent, with lateral line ossicles insufficiently ossified to be observed. Lateral line extending along side of body from edge of operculum to a vertical with first of procurrent caudal rays, and slightly above middle of body.

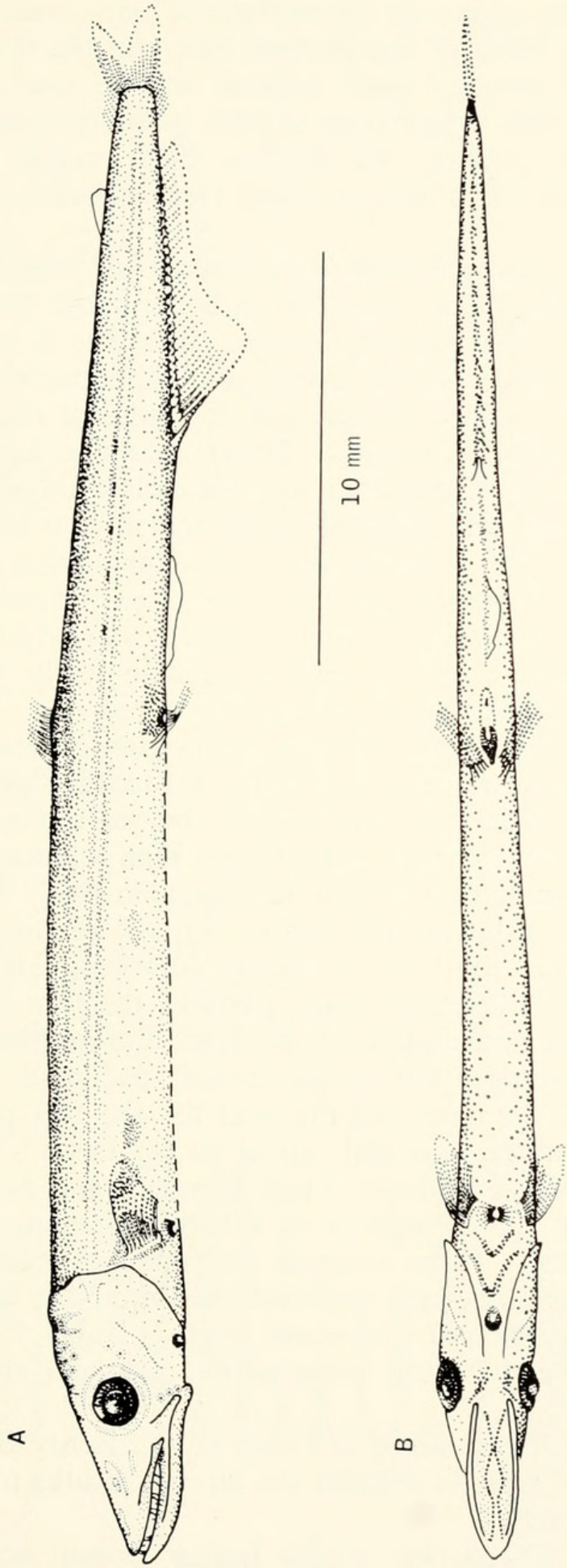


Figure 1. Side and ventral views of *Lestidium bigelowi*, new species, drawn from the holotype — 37.2 mm in standard length (MCZ 44881).

Three luminous organs on the midventral line — one at isthmus, another between bases of the pectoral fins, and the third between bases of ventral fins and anus. Isthmal and pectoral organs imbedded in flesh; anal organ close to skin, possibly open to surface or connected to rectum. In alcohol, these organs are black with a translucent, white layer at center (see discussion of luminous organs, below).

Head pointed and moderately long, widest just posterior to eyes. Snout length slightly more than two in head, about three-quarters as wide as head. Eye and pupil large, about five in head length; eye and pupil round; adipose eyelid present. Interorbital slightly concave, with two lateral, compressed, longitudinal ridges on each side. Occiput rounded, convex. Nasal apertures approximately halfway between tip of snout and eye. Opercle with posterior edge moderately pointed and notched about pectoral fin base. Mouth large, lower jaw with a slight non-ossified projection. Premaxillary extending to a point beneath anterior edge of orbit. Premaxillary with two or three depressible canines, posteriorly followed by fixed teeth. Palatine with a few depressible teeth. Gill rakers present but poorly developed on first two arches.

Dorsal fin origin slightly anterior to origins of ventral fins, a little more than halfway back on body. Posterior edge of adipose fin anterior to caudal peduncle, slightly before last anal fin ray. Inner rays of ventral fins distinctly longer than the outer. Ossification is too incomplete to permit radiographic study of vertebral column or study of lateral line ossicles through staining.

In ethyl alcohol the body is largely colorless. Melanophores, most of them stellate, cover many parts of the fish: the occiput, the edges, ridges and sutures of the jaws, the angular bone, the dorsum, the posterior part of the caudal peduncle, the ventral midline between the anus and the anal fin, the first pectoral and anal fin rays, and the anal and caudal fin ray bases. The angular bone is also covered by heavy black pigment, and the dorsum is covered by light brown pigment in a band becoming denser and darker posteriorly. Three anterior and one posterior peritoneal sections are relatively clearly outlined; the others are indistinct.

All measurements and counts are given in Table 1, and reconstructed lateral and ventral views of the holotype are shown in Figure 1.

This new species is named in honor of Dr. Henry Bryant Bigelow, to whom I wish to express my sincere thanks for his kindness and generosity.

*Distribution:* Taken only in the Indian Ocean, approximately 650 miles northeast of Madagascar at a depth above 750m.

TABLE 1

Proportional Measurements in Percent of Standard Length

| | *Lestidium bigelowi* | *Lestidium atlanticum* | *Lestidiops jayakari* | *Lestidiops indopacificum* |
|---|---|---|---|---|
| Head length | 20.8-21.8 | 22.4-22.9 | 18.5-22.0 | 20.3 |
| Snout length | 8.9-9.2 | 10.1-12.4 | 7.6-10.2 | 7.1 |
| Snout to anus | 59.9-60.0 | 59.8-64.1 | 55.7-64.6 | 58.4 |
| Snout to dorsal fin | 54.3-54.9 | 56.3-60.0 | 56.5-61.0 | 53.9 |
| Snout to anal fin | 75.0-77.4 | 75.4-79.2 | 76.7-79.4 | 76.8 |
| Snout to ventral fin | 56.0-56.2 | 56.8-59.6 | 48.4-58.0 | 54.8 |
| Dorsal fin to ventral fin | 1.4-1.6 | 0.0-0.5 | 2.3-6.5 | 0.9*-1.2* |
| Dorsal fin to anal fin | 15.5-18.8 | 19.8-20.0 | 19.6-22.1 | 22.0*-22.9* |
| Dorsal fin rays | 9-10 | 9-10 | 10 | 10 |
| Anal fin rays | 28-29 | 29-30 | 28-30 | 29-32 |
| Body depth | 8.5-8.9 | 8.0 | 6.7-9.1 | 10.0 |
| Caudal peduncle depth | 3.2-3.5 | 2.4-2.7 | 2.3-3.2 | — |
| Eye diameter | 4.0-4.6 | 3.9-4.4 | 3.4-4.9 | 4.5 |
| Upper jaw length | 9.7-10.9 | 10.3-10.5 | 8.2-10.0 | — |
| Premaxillary to eyes | 0.7-0.8 | 1.4-2.2 | 0.5-1.4 | — |
| Dorsal fin to caudal fin | 41.7-45.1 | 35.9-36.7 | 35.2-40.0 | 41.9[x] |
| Anal fin to caudal fin | 5.9-6.0 | 5.2-5.9 | 5.3-6.5 | 1.9 |
| Adipose fin to caudal fin | 6.3-8.3 | 5.5-5.8 | 5.1-7.0 | 2.6 |
| Dorsal fin base length | 4.8-5.3 | 3.6-4.4 | 3.6-5.0 | 4.2 |
| Anal fin base length | 18.8-19.4 | 15.2-17.5 | 15.7-18.5 | 19.0 |

* Taken from Ege's illustration.

[x] Computed from: total length — (predorsal + dorsal base length).

*Relationships:* In relative proportions and numbers of fin rays, *Lestidium bigelowi* closely resembles *Lestidium atlanticum* Borodin, *Lestidiops jayakari* (Boulenger), and *Lestidiops indopacificum* (Ege). The ranges of meristic characters shown by the species in these two genera provide no grounds for separation. Analysis is further impaired by discrepancies evident in the monograph recently published by Rofen (1965), for the proportionality data provided in certain of his tables (e.g., table XXIV, pp. 302-303) are at variance with those reported in his description (e.g. that of *Lestidium atlanticum* on pp. 308-309). The single valid and conservative character which does separate *Lestidium* from *Lestidiops* is the presence or absence of an internal light organ; hence the species described here is relegated to *Lestidium.* The meristic data taken from this species are compared in Table 1 with those for *Lestidium atlanticum* and *Lestidiops jayakari* taken from Rofen's description (1965: 308, 348), and for *Lestidiops indopacificum* taken from Ege (1953).

*Anatomy of the luminous organs:* The three organs differ somewhat from one another in gross morphology. The anterior one (the isthmal) is buried in the muscle of the isthmus (Fig. 1A, B). It has a black cup-shaped structure with the opening directed

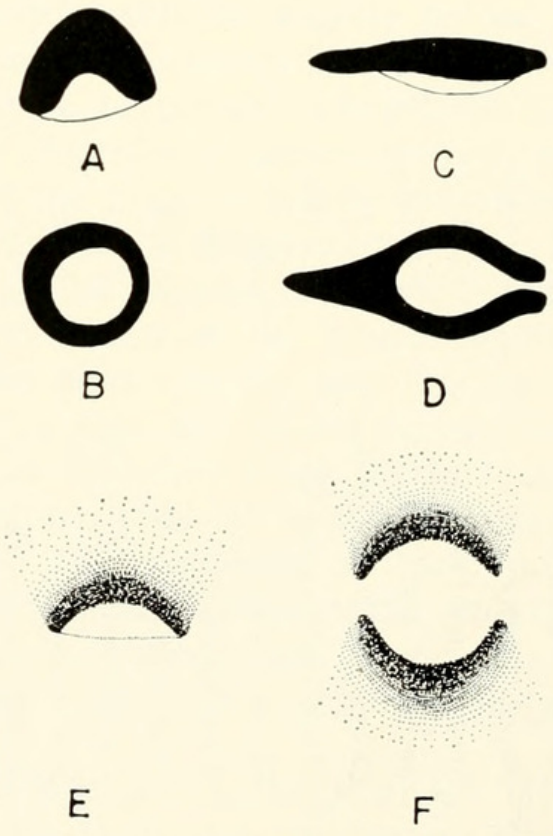


Figure 2. Photophores of holotype: A and B, lateral and ventral views of isthmal photophore; C and D, lateral and ventral views of anal photophore; E and F, lateral and ventral views of pectoral photophore.

posteroventrally and is covered by a mass of translucent tissue (Fig. 2A, B). The middle one (the pectoral) is nearer the surface than the isthmal (Fig. 1A). It too has a black, ventrally directed cup, covered with a translucent cap; its black pigment seems to be associated with the peritoneal lining (Figs. 1A, B; 2E, F). The posterior one (the anal) is close to, or partially embedded in, the skin (Fig. 1A, B). As seen from the ventral side, it has an arrowhead-shaped mass of black tissue surrounding a central translucent cap (Figs. 1B; 2C, D). There may be an opening directed posteriorly toward the anus or the surface from the central part of this photophore (Fig. 2D).

The isthmal photophore of the paratype was removed, and sectioned by William O'Day, using the following procedure: the fish was fixed whole in formalin aboard ship, and then transferred to 72% ethanol for preservation. The photophore was excised and dehydrated for twenty-four hour periods in 100% ethanol, 100% n-propanol, and 100% n-butanol. It was then infiltrated in one cc of pure glycol methacrylate with a polymerization catalyst, and transferred to fresh monomer and polymerized in a gelatin capsule at 60°C. After polymerization, the sections were cut vertically through the photophore at one micron thickness by a Porter-Blum microtome. The sections were stained first with 4% acid fuchsin in water for four minutes, and then with a concentrated solution of toluidine blue in water for five minutes. The sections were mounted on a slide and covered with a Permount cover slip (see Ashley and Feder, 1966).

The isthmal light organ (Fig. 3) is a classical example of a photophore (e.g. see Brauer, 1908, fig. XXX). It consists of a cup of heavy black pigment surrounding an internal body of granular tissue. On examination under high magnification the latter material does not seem to be associated with bacteria, implying that the luminescence of at least this organ is glandular in nature. The cup is closed ventrally by a lens-like layer of cells which separates the luminous tissue from a gelatinous cap. This cap completely covers the ventral aspect of the photophore and may serve to filter, focus, or disperse the light emitted.

The structures of the light organ resemble those found in other fishes, especially the myctophoid inioms. They do not appear to be similar to those described by Haneda (1958) for *Lestidium prolixum* Harry or *Lestrolepis japonicum* (Tanaka). They do, however, look like those found in the family Myctophidae except for the presence of an internal lens. However, since the Paralepididae are so dissimilar to the Myctophidae in other respects, the similarity of the photophore of *L. bigelowi* to those of

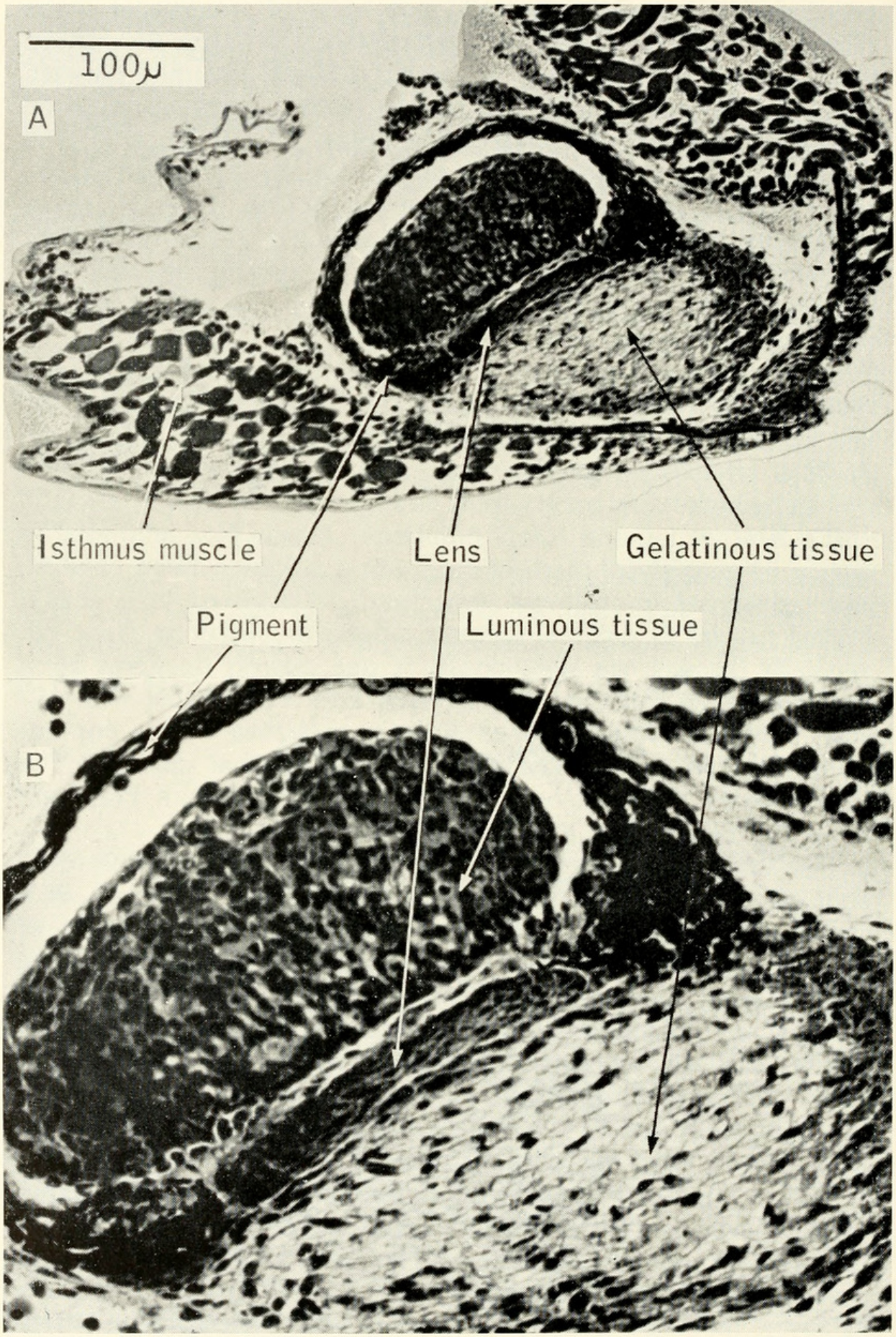


Figure 3. A, a vertical section through isthmal photophore. B, the photophore above, enlarged.

the myctophids is assumed to be due to convergence rather than to close relationship.

The anal photophore of *Lestidium bigelowi* is similar in shape to that discussed by Bertelsen, Theisen, and Munk (1965) for the argentinoid fish, *Rhynchohyalus natalensis* (Gilchrist and von Bonde). Like that of *R. natalensis,* the anal photophore of *L. bigelowi* may be connected to the anus (though posteriorly instead of anteriorly), and its luminescence may thereby also be bacterial in nature. As the anal photophore on the holotype was the only one found, the paratype being mutilated in that region, no sections were made of it; thus the question of whether this luminescence is bacterial or glandular can not now be answered.

## SUMMARY

A new species of *Lestidium* was collected in the Indian Ocean in 1964. It most nearly resembles *Lestidium atlanticum* Borodin in proportions and counts, and in some other respects is similar to *Lestidiops jayakari* (Boulenger) and *L. indopacificum* (Ege). It differs from all other paralepidids in possessing discrete photophores. These photophores have a darkly pigmented cap, with opening directed ventrally, and are covered by a gelatinous, translucent mass of tissue. Photomicrographs of the isthmal photophore of the paratype show that it is very similar to those of the Myctophidae, differing significantly only in the possession of an internal lens. This similarity is attributed to convergence rather than to close relationship.

## LITERATURE CITED

Ashley, C. A. and N. Feder

1966. Glycol methacrylate in histopathology. Arch. Path. **81**:391-397.

Bertelsen, E., B. Theisen, and O. Munk

1965. On a postlarval specimen, anal light organ, and tubular eyes of the argentinoid fish *Rhynchohyalus natalensis* (Gilchrist and von Bonde). Vidensk. Medd. fra Dansk Naturh. Foren., **128**: 357-371.

Brauer, A.

1908. Die Tiefsee-Fische II. Anatomischer Teil. Wiss. Ergebn. Deutsch. Tiefsee Exped. auf dem Dampfer Valdivia 1898-99, **15**(2); 1-153, pls. 11-30.

Ege, V.

1953. Paralepididae I (*Paralepis* and *Lestidium*): taxonomy, ontogeny, phylogeny, and distribution. Dana Rep., **40**: 1-184.

HANEDA, Y
1958. Preliminary report on a luminous fish of the family Paralepididae. Sci. Rep. Yokosuka City Mus. **3:** 31-35.

HUBBS, C. L. AND K. F. LAGLER
1947. Fishes of the Great Lakes region. Cranbrook Inst. Sci., Bull. No. **26:** 1-186.

ROFEN, R. R.
1965. Paralepididae. Pp. 205-443, *in* Fishes of the Western North Atlantic (G. W. Mead, ed.), Mem. Sears. Found. Mar. Res., Yale Univ., No. **1,** Pt. 5, 647 pp.

(Received 3 May 1967.)