ON THE COMMON WHITING OF MORETON BAY

(*Sillago Bassensis*).

(Plates VIII.—XIV.)

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Sillago Bassensis, Cuv. & Val. Poiss. III., p. 412.

Synonyms.—*S. Terrae-Reginae.* Cast., Proc. Lin. Soc., N.S.W., vol. II., p. 232.

S. ciliata. Gunth. Cat. Fishes II., p. 245.

S. de Bass. Quoy and Gaymard, voy. Astrolabe, Poiss., pl. I., fig. 2.

S. Bassensis. Cast. Proc. Lin. Soc., N.S,W., vol. III., p. 380.

Local names—whiting, trumpeter whiting. There has been some confusion as to this species. Cuvier and Valenciennes give the fin formula as D. 11—1/18, A. 1/12, and immediately thereafter, "Il y a deux epines à son anale."

Count Castelnau—*loc. cit.*—describes as *S. Terrae-Reginae*, a whiting caught in great numbers in Moreton Bay with this formula, D. 10—1/18, A. 2/15, L. lat. 64, but in the next volume of the same publication he goes back to *S. Bassensis*.

Dr. Gunther under the name *S. ciliata* gives a description that fits the common Moreton Bay whiting, but Cuvier and Valenciennes, who established the species, say distinctly it has no silvery streak along the side. This streak Gunther adds, and as it stands his description of *S. ciliata*, fits *S. Bassensis* better than any I have seen of the latter species.

The *S. de Bass*, figured by Quoy and Gaymard, differs from the Moreton Bay fish in several particulars. The teeth are too large. The first ray of the ventral fin is not prolonged into two feeler-like filaments. The denticulations of the operculum are too prominent and do not extend forward from the angle. The first dorsal fin has 12 spines instead of 11. The markings on the dorsal fins are spots. In Queensland specimens they are on the first dorsal irregular blotches, and on the second blotchings fairly regular in shape and arranged in rows. The anal fin shows 2/19.

The formula is D. 11—1/17; A. 2/16; V. 1/5; P. 15; L. lat. 63; L. trans. 5/12. The back is coloured to resemble the sandy ground over which the fish moves. When freshly taken it varies from a yellowy green in fair sized fish to a greeny grey in old specimens—parts of the scales showing silvery in some lights, with here and there a fleck of gold. After being out of the water some time the back is silvery blue or golden green, according to how the light falls. The head is of the same colour as the back but becoming dark in old fish. There is much variation in the colour of the under side of the head—usually white but often with much dark colouring. The colour of the back shades down into a silvery grey on the lower parts of the sides and an enamel white on the belly. The broad median band is of a silvery yellow becoming indistinct with age. The band often disappears in preserved specimens.

The first dorsal fin has brown blotches on the membrane between the rays. In the second dorsal the blotches are small and in rows—from 3 to 5 blotches between every two rays. The anal is yellow. The ventrals are orange yellow. The pectoral is transparent with a blue black spot at the base. The under lobe of the tail is usually much worn.

The opercle is finely denticulated on the angle and vertical margin. Small teeth are in both jaws on the vomer and palatines. The anterior nostril has a small pointed flap on its back edge. The pupil of the eye is not round but drawn to a corner in front and on the under side—the corner in front is the more conspicuous. The scales are ctenoid.

The whiting is one the most valuable of the food fishes in Queensland. A good-sized fish attains a length of 17 inches and weighs a pound and a-half. The name whiting was given because the flavour of the flesh was considered to resemble that

of the whiting of British waters. The latter species is one of the haddock family. The species under discussion at present belongs to the *Trachinidae*.

Spawning Season.

The spawning time of the whiting may be stated to last from September to February. The first ripe fish taken were large males in June. Ripe females occured in fair quantity in September. In a female specimen just over 16 inches long and weighing 1lb. 8¾ ozs. the weight of the ovaries was 3½ ozs., or about 14 per cent. of the total body weight. The fish were observed to have been feeding at intervals during the process of spawning.

Development.

The egg of the whiting is small, measuring from ·68 to ·69 mm in diameter, and contains one oil globule, measuring about ·18 mm in diameter (Pl. VIII. fig. 1.) It is a transparent sphere, and is pelagic. On the perivitelline membrane are a number of faint lines, wrinklings or thickenings of the membrane. The pores in the outer capsule are visible for only a very short time after extrusion. The oil globule is not altogether transparent, but shows a black edging.

After about 15 minutes in the water, the segmental disc (d. fig 2), shows on the under side of the egg. Fig. 3 is a side view of the disc just before segmentation begins. After fertilisation, cell division begins—the 2-cell stage being reached when the egg has been half-an-hour in the water. Thereafter the disc divides rapidly into 4, 8, 16, 32 cells—the last-mentioned stage being reached at 1hr. 35mins. No horizontal divisions could be seen at the 16-cell stage. Figs. 8 and 9 are the large- and small-cell morula stages—the latter occuring at 2hrs. 40mins. Thereafter the cells become smaller rapidly, and proliferating at the edge of the disc begin to envelop the yolk mass. Fig. 10 at 8¾hrs. shows the blastoderm almost covering the yolk. (The oil globule has been omitted in figs. 3 to 10).

When the enveloping process is all but completed, the embryonic streak (em. fig. 11), is visible. At the same time, 9¾hrs., pigment cells appear on the blastoderm especially over the oil globule. They are of a light grey colour, and irregularly stellate in shape. By 10 hrs. 40mins., the embryo is clearly outlined—the tail being twice as broad as the head. Pigment cells of a thin grey show on the body, the oil globule and on the

membrane near the tail. Yellow cells show along the sides of the body. The wrinklings are now much diminished. At 12½hrs. (fig. 12), the embryo shows the optic lobes, notochord and Kuppfer's vesicle. At 14½hrs., Kuppfer's vesicle begins to be narrowed, and distinctly pointed towards the capsule as the tail elongates. Then it gets smaller, and appears to retreat from its position at the tip of the tail, and ultimately disappears after having existed for about 3 hours. Fig. 13 shows the optic lobes cut off, and the appearance of the muscle flakes on the body. At this stage, the rounded ends of the myomeres give a crenated appearance to the sides of the body. At 17½ hours, the heart shows as an aggregation of cells on the breast, and an hour later is beating faintly. In fig. 14 at 19 hours, the optic vesicles have been invaginated, and the tail is slewed to one side of the oil drop. Fig. 15 is a side view of the stage shown in fig. 14. The heart (ht.) in a capsule under the chin, is a tube extending from the median line to the left and forward. The choroidal fissure of the eye is seen. Fig. 16, 22 hours, shows the otocyst and a membrane enveloping the oil globule. Just before hatching, a part of the continuous fin shows on the tail. The eggs from which the series of drawings so far were taken hatched at 23½ hours from time of extrusion. The temperature of the water ranged from 25·6° to 27° C.

The larvae figured on Plates X. and XI., were hatched in colder weather—temperature 22° to 23° C. The stage shown in fig. 17, occurred at 38 hours after extrusion. The continuous fin (c.f.) is well developed, and the vent and the urinary vesicle behind it are seen. The yellow pigment has taken its characteristic early larval arrangement. In figs. 18 and 19 the gut is shown forming and stretching forward to the yolk, while a few finely branching pigment cells show on the membrane enclosing the yolk. At 70 hours the pectoral fins make their appearance (fig. 20). The membrane enclosing the yolk, which has up to this stage maintained its position, as the yolk and oil globule diminished in size, now suddenly collapses, and the yolk moves forward. While the membrane remain d turgid it interfered with the locomotion of the larva, which was forced to swim in circles, but from this onward the young fish swims actively. Soon after hatching when the larva is floating passively, the position is horizontal and supine. From the stage shown at fig. 19, the position is vertical with the tail upmost.

Fig. 22, Plate XI., shows the beginning of the mouth cleft (m). Fig 23 is a top view of 22, and shows along the middle of the body a number of small clear bodies—usually 8 in number. The small circle on the continuous fin, close to the back, in fig. 20, should not be there, but it represents one of these bosses on the left side of the body seen obliquely through the fin. They do not show at all on a side view. Fig. 23a is a horizontal long section through one of these bodies. It is an epidermal structure with an almost glandular appearance enclosed in a split in the epidermis, and having no evident connection with the underlying layers of tissue. In the live animal these bodies are slightly stained by a very weak solution of Methylen Blue. At this stage the larvae are very active.

Fig. 24—at 4 dys. 16½ hrs.—shows the mouth formed and the yolk with the oil globule reduced almost to the vanishing point. The branching pigment cells disappear from the continuous fin, and later are replaced by a few branching spots. Pigment is developed in the retina. The stomach and liver are formed. In figs. 25 and 26 the body is beginning to become opaque—the notochord showing as a lighter streak in the median line. The gut is now completed, and some of the divisions of the brain can be seen. Scales are formed at about one month.

The times and sizes of the stages figured are given below.

Habitat and Habits.

Soon after the beginning of the spawning season young whiting of 10 mms. and over can be observed swimming actively in small droves of from 10 to 20 on sand flats and beaches. They move up and down with the tide, swimming in very shallow water. As they grow older they keep further from the shore. The whiting may be said to live almost exclusively on sandy ground. The adults appear to be gregarious only at spawning time.

The most characteristic habit of the whiting is that of burrowing in the sand to escape from enemies. In so doing the fish literally dives into the sand. The dive can be executed with great rapidity and is a most serviceable accomplishment. When fishing for whiting with a seine net one can observe as the bunt of the net nears the shore here and there a small cloud of sand thrown up; the fisherman marks the place, and when his net is in, wades out and feels about in the sand with his feet; when a

fish moves under his foot he stamps his foot down to hold it there, and then picks it up with his hand. Often as many as a dozen fish are so taken which had otherwise escaped the foot-rope of the net. Very small whiting, an inch and a-half long, have the trick. When burying the whiting throws up its tail, and actually takes a header into the sand using its tail fin vigorously. Once the head is under, it appears to throw up like a diver, and when buried has got into a horizontal position. The whiting can remain down for 2 or 3 minutes. On an ordinary sand flat, a whiting can bury itself to a depth of from 3 to 4 inches, but on a hard sand beach, it can hardly cover itself. The eyes, in such a case, show plainly against the sand, but immediately the net has passed over, the fish is up and away.

When taken the whiting often makes a short, croaking, frog-like sound—whence the name trumpeter.

Food.

A common article of diet is a small perch, *Ambassis marianus*,* which abounds in Moreton Bay. It is usually about 1½in. long, though the giants of the race attain a length of 4in., and may be seen in shoals near every jetty in the Bay.

Two species of crustacea are favourite food of the whiting, one the common soldier crab, *Mycteris longicarpus*, and the other locally known as the sand lobster, *Callianassa sp.* or an allied form (pl. XII., fig. 4). The soldier crab can burrow corkscrew fashion into the sand to escape attack, and the sand lobster lives for the most part in a network of tubes it has excavated in the sand, though in warm weather it is said to come to the surface.

Another item in the food list is evidently considered by the whiting to be a tit-bit. It is the proboscis of a spoon-worm (pl. XII., fig. 3.) . This worm lives in sand with which there is a good deal of mud. The body is from 9in. to a foot down, but the spoon or proboscis is sent up to feel round for food. The tube, in which the worm lives, opens usually about the middle of a slight hollow on the sand surface. In this depression, about 6in. of the proboscis is moved slowly about lying flat out from the mouth of the tube. The proboscis is very extensile, and very sensitive and can be withdrawn with great rapidity on the approach of danger. It is very interesting to watch a

*Kindly identified for me by Mr. J. Douglas Ogilby.

whiting stalk one of these worms. The fish swimming low down carefully approaches one of these hollows, and after manoeuvering for position, suddenly makes a dart for the opening of the hole. All that falls to the share of the whiting is about half-an-inch of the lip of the rapidly retreating snout. The snout can be used effectively as bait. Both the sand-lobster and the spoon worm can be taken in quantity between tidemarks. Young whiting feed on small sand crustacea, and worms.

I think it possible to connect the whiting's habit of burying in the sand with the fact that it hunts its food largely among animals that take refuge there.

The Ventral Fins.

The ventral fin of the whiting is peculiar in having the first ray forked only once, and the divisions of the ray prolonged a quarter-of-an-inch or more beyond the tip of the fin. In swimming along the bottom the tips of the ventral fins are trailed over the surface, and the prolongations of the first ray look somewhat like feelers. These prolongations are much larger proportionally to the size of the fin in young fish than in adults. Moreover in fish up to a year old, the ventral fins are whitish and more noticeable than the orange yellow fins of the old fish. No special innervation could be detected for these elongations though they are probably to a certain extent tactile. Their development in the young fish is figured on Plate XIII. The smallest whiting that could be taken with ventral fins was 13 mms. long. The fins were 1 mm. (fig. 1). They consist of a long process that would become the first ray, and the spine is represented by a pretty broad flap. Fig. 2 shows the spine and the first 2 rays in a fish 17·5 mms. long. The first ray has forked and the division next the spine has grown out into a filament. Figs. 3, 4 and 5 show the other division growing out after the first. In fig. 7 the filaments are of about equal length in which condition they remain. Later the other rays fork four times. Fig 6 is a sketch of a sport in which the first ray tried to divide into four. Three of these divisions became elongated, but the fourth appeared to be undergoing atrophy. The other ventral fin in this specimen was normal.

Markings.

The young of *S. Bassensis* are marked somewhat similarly to *S. maculata*. The markings practically disappear at about two years. In a whiting about 6 months' old, the markings are

dark blotches—with no evident arrangement—on the upper side of the body. At one year (Pl. XII., fig. 1) they begin to assume the oblique arrangement described for *S. maculata* ; at two years they have run into one another to form about eight oblique irregular bands running downwards and forward. By that time they are very indistinct, and can be shown or not according to environment. In no case do the markings show below the lateral silvery band or on the tail (cf. *S. maculata*, Bleeker, At. Ich. Ind., T. 8, Tab. 389, Fig. 5). Well-grown fish when just taken from the water show sometimes from 6 to 8 dark areas, extending about $\frac{3}{4}$in. out from the median dorsal line. They disappear when some time out of the water. The dark colour is not even in the blotchings which have rather a mottled appearance.

The markings on the young whiting, when seen from above in its natural surroundings, counterfeit very accurately the shadows of the ripples on the sand surface below.

Rate of Growth.

Observations on the whiting were in progress from June to January. Early in June young whiting of last season's spawning can be taken at lengths varying from 31 to 79 mms. Averages of sizes divided arbitrarily into two groups—those over 50 mms. and those under—give approximately the lengths attained at that time by those spawned early and those late in the season. At 10th June averaging 40 of each group, the early spawned fish were 68 mms. and the later ones 40 mms. On 24th June the average of all sizes was 70, and on 19th August 72 mms. On 7th October, at the beginning of the spawning season, the average was 76 mms., or about three inches. At the same time the average size of a number of two-year old whiting was found to be 201 mms., or about eight inches. That was of course early in the spawning season, and the sizes of one and two-year old fish probably exceed slightly those given. These two-year olds had reproductive organs of small size, but well advanced. They spawn in the early months of the year. It is very probable that fish spawned late in the season do not breed till the third year.

LIST OF FIGURES IN THE PLATES.

			Mins. after extrusion.	
Pl. VIII, Fig.	1.	Egg on extrusion		
	2.	Germinal disc	15 mins.	
	3.	Side view of 2	20 ,,	
	4.	2-cell stage	30 ,,	
	5.	4-cell ,,	45 ,,	
	6.	8-cell ,,	58 ,,	
	7.	16-cell ,,	1hr. 20mins.	
	8.	Large cell morula	1hr. 55mins.	
Pl. IX.	9.	Small ,, ,,	2hs. 40mins.	
	10.	Blastoderm enveloping yolk	8¾hrs.	
	11.	Embryonic streak	9¾hrs.	
	12.	Embryo	12½hrs.	
	13.	,,	15¼hrs.	
	14.	,,	19hrs.	
	15.	,, side view of 14	,,	
	16.	,, shortly before hatching	22hrs.	
Pl. X.	17.	Larva	38hrs.	1·4 mms. long.
	18.	,,	48hrs.	1·6 ,,
	19.	,,	63hrs.	2·1 ,,
	20.	,,	70hrs.	2·1 ,,
	21.	,,	3dys. 14hrs.	2·2 ,,
Pl. XI.	22.	,,	4dys.	
	23.	,,	,,	
	23a.			
	24.	Larva	4dys. 16½hrs.	2·5 mms.
	25.	,,	5dys. 16hrs.	2·3 ,,
	26.	,,	6dys. 16hrs.	2·4 ,,

Pl. XII.

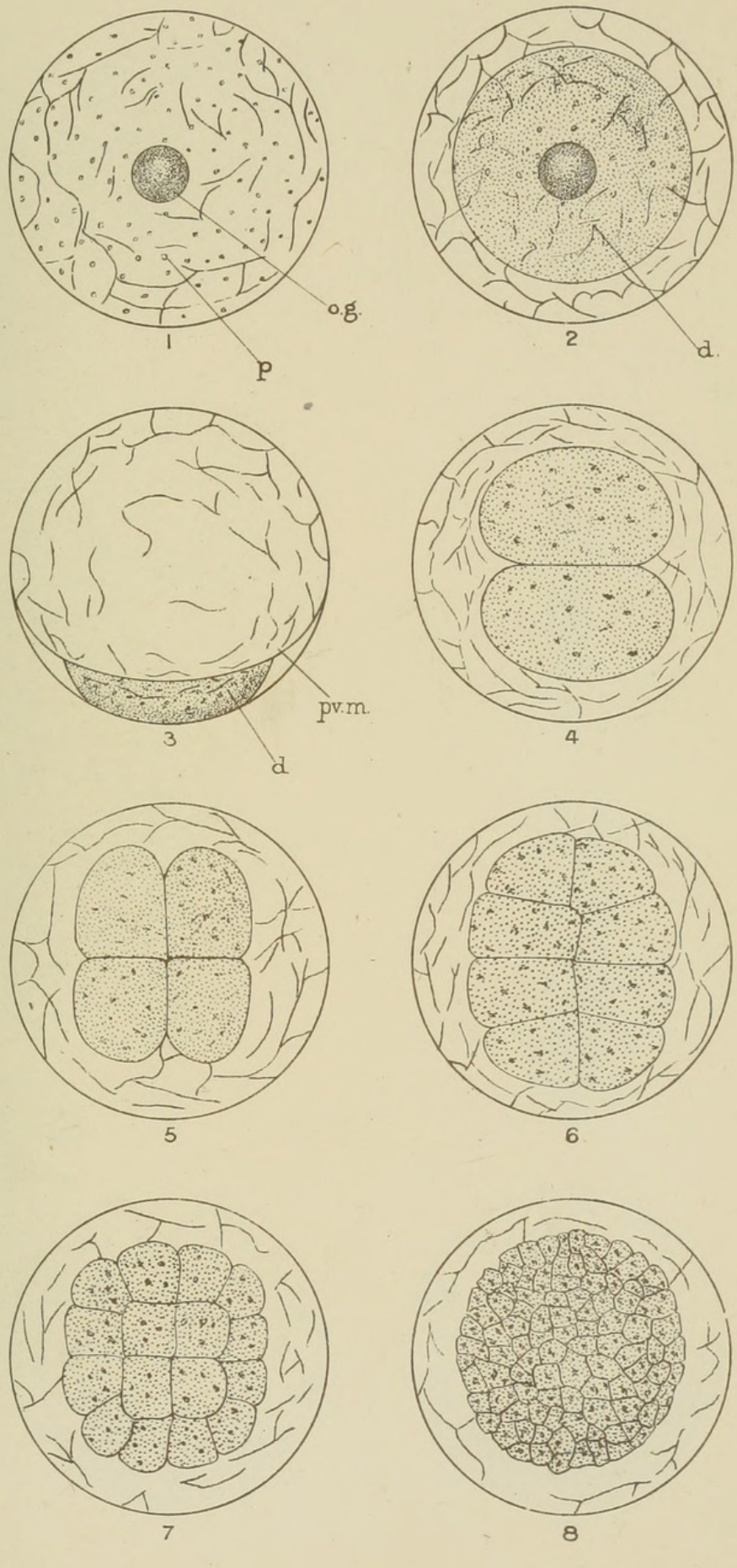
1. Whiting one year old. Nat. size. Well grown. Showing markings.
2. Whiting about 6 weeks.
3. Food of whiting—sand worm—*Thalassema sp.*
4. ,, ,, sand lobster.

Pl. XIII.	1.	Ventral fins of whiting	13 mms. long.	Nat. size	1 mm.
	2.	Spine & 2 rays of ,,	17·5 ,, ,,	,,	2·4 ,,
	3.	,, ,, ,,	19 ,, ,,	,,	3·0 ,,
	4.	Spine & first ray of ,,	21 ,, ,,	,,	3·2 ,,
	5.	,, ,, ,,	23 ,, ,,	,,	3·6 ,,
	6.	,, & 3 rays of ,,	40 ,, ,,	,,	6·6 ,,
	7.	Ventral fin of ,,	29 ,, ,,	,,	5·1 ,,

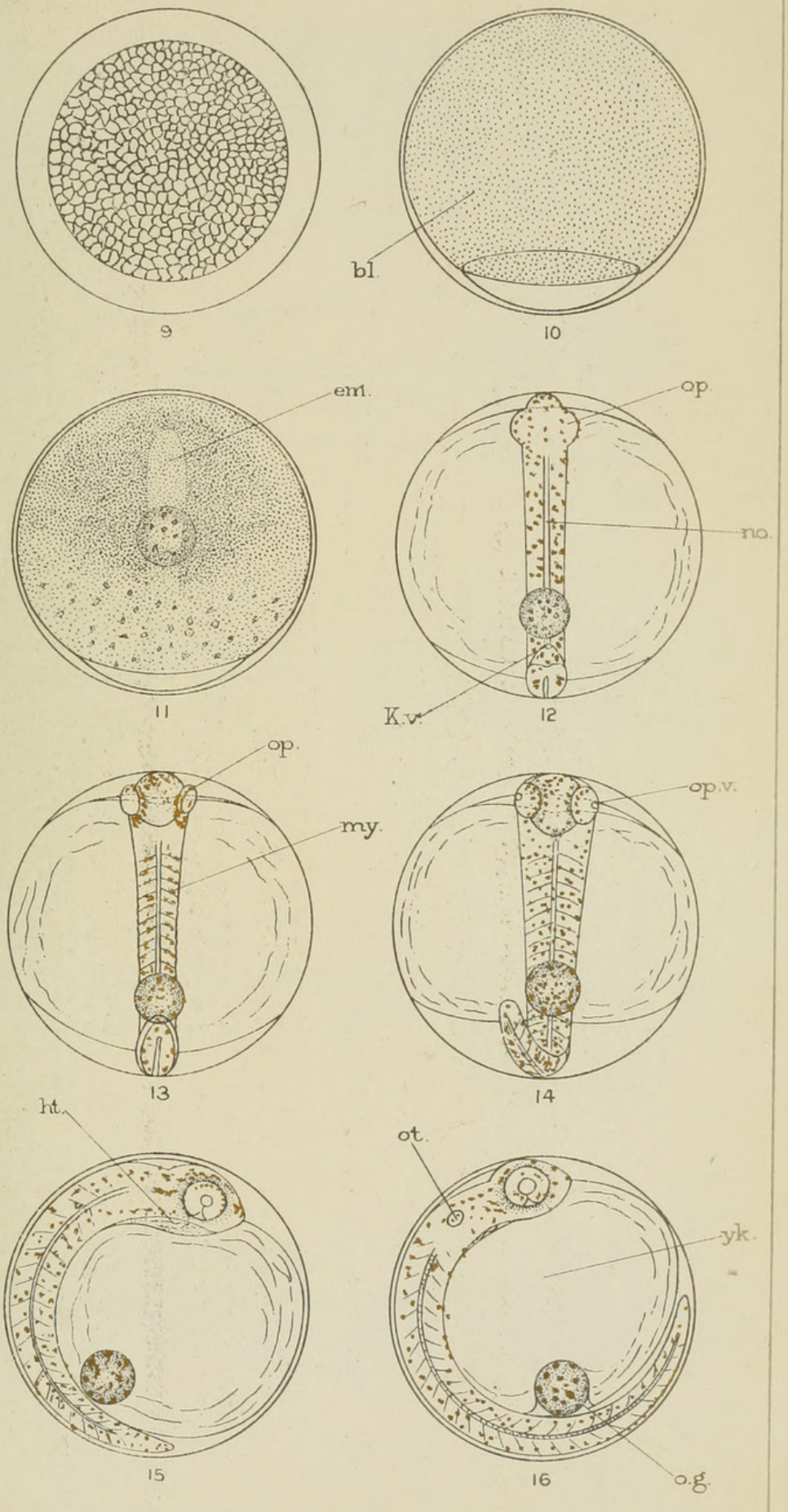
Pl. XIV. Adult whiting. *Sillago Bassensis.* Length of specimen, 11¼in.

ABBREVIATIONS USED IN THE PLATES.

a. anus
bl. blastopore
c.f. continuous fin
ch.f choroidal fissure
d. disc
em. embryo
f.b. fore brain
ht. heart
i. intestine
K.v. Kuppfer's vesicle
m. mouth
m.b. mid brain
my. myomere
no. notochord
o.g. oil globule
ol. olfactory
op. optic lobe
op.v. optic vesicle
p. pore
p.f. pectoral fin
pv.m. perivitelline membrane
s.b. sensory body
u.v. urinary vesicle
yk. yolk



J. R. Tosh del. W. H. Greenfield lith.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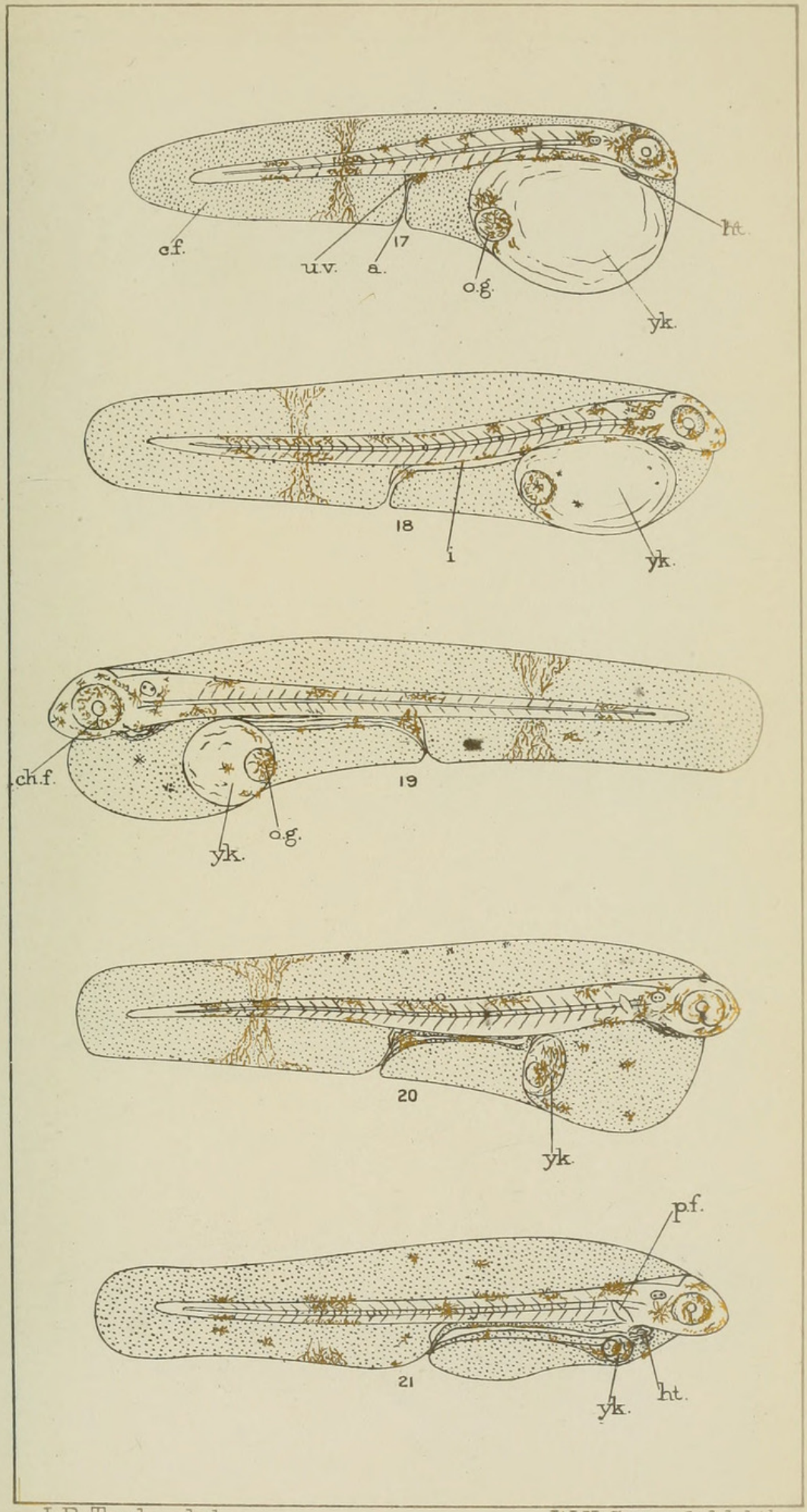

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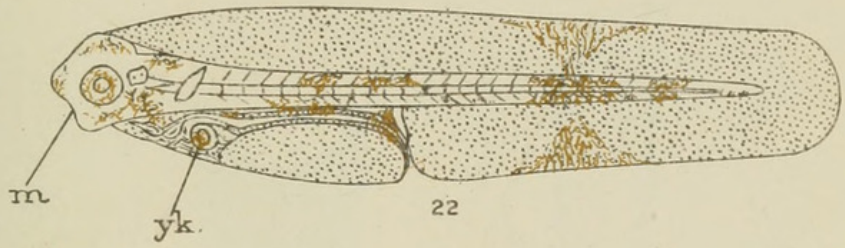

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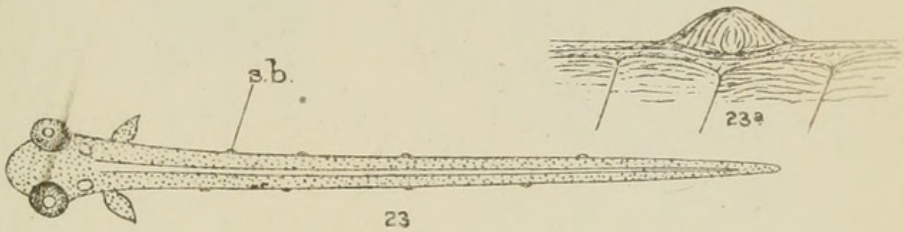

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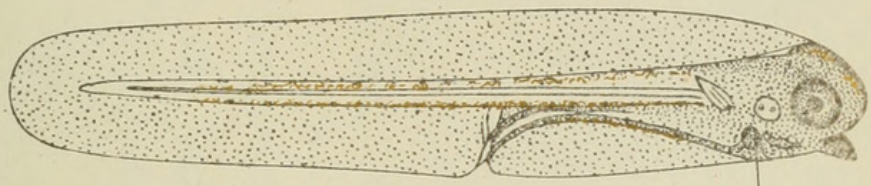

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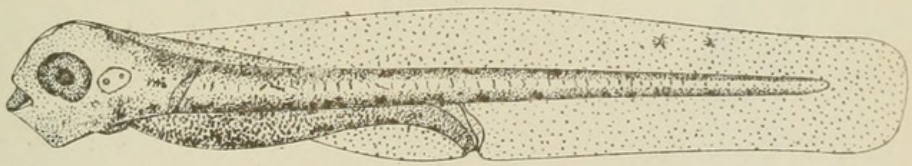

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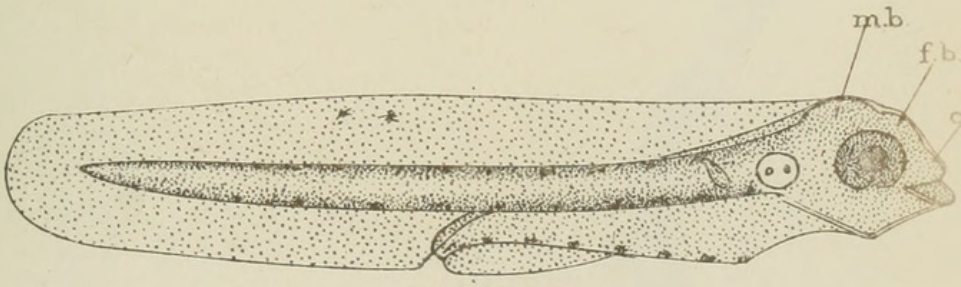

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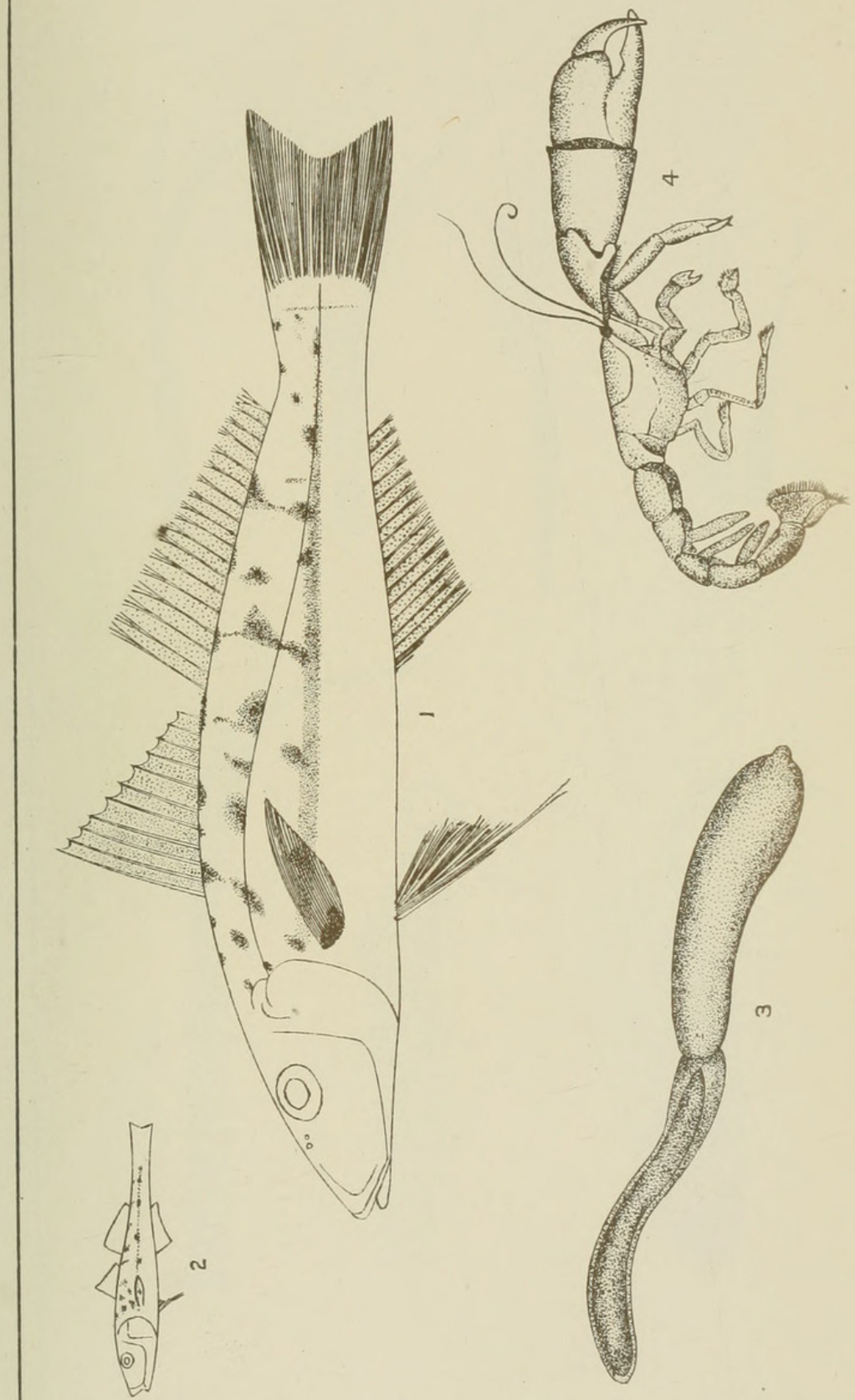

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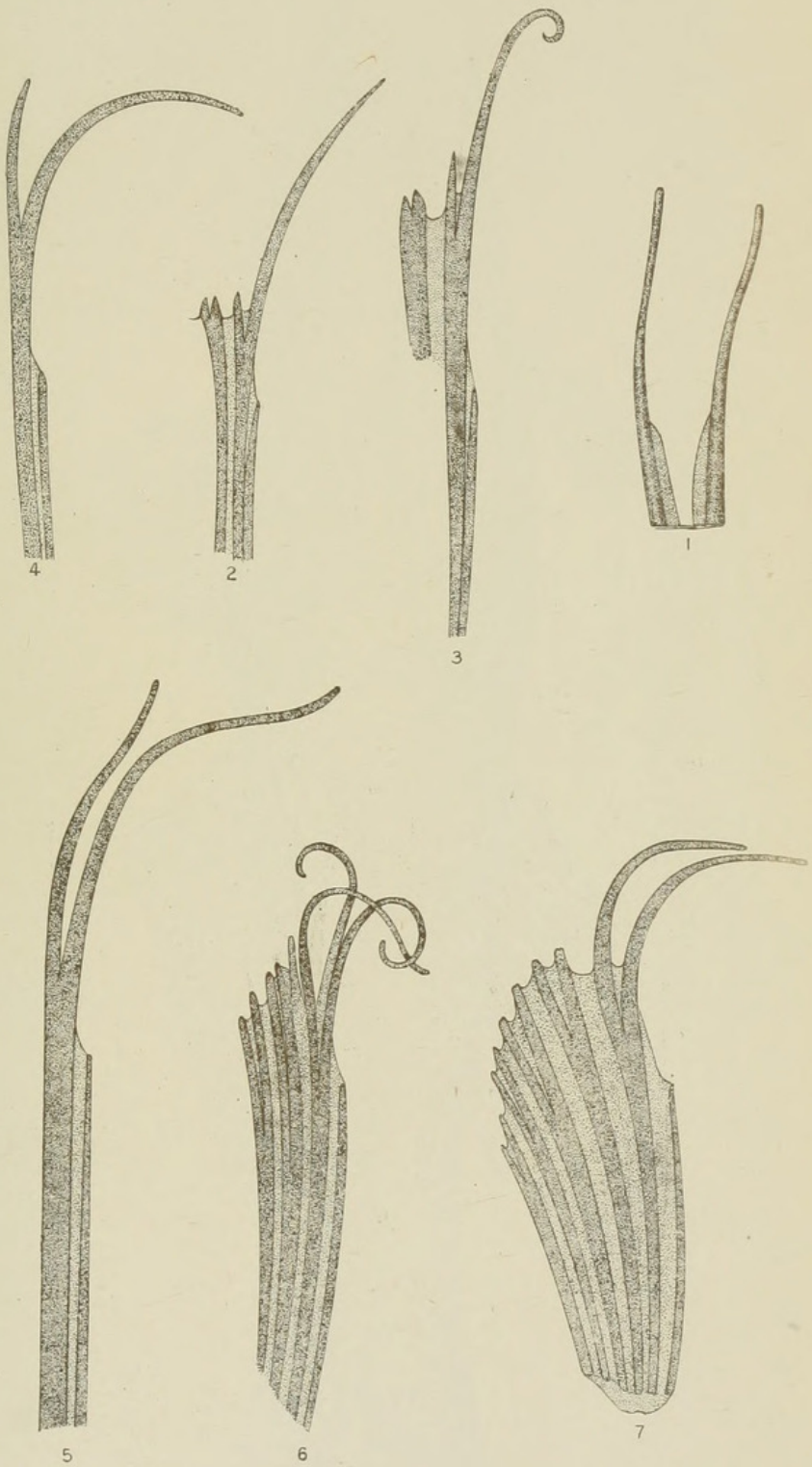

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