No. 6. — *Descriptions of Two Species of Octopus from California.*
By A. E. VERRILL.

IN the following paper the large *Octopus punctatus*, which inhabits the Pacific coast, from San Francisco to Sitka, is described and figured more fully than hitherto. A new species, known to the author for many years, is described under the name of *O. bimaculatus*, a name intended to recall the presence of two large dark spots, one in front of each eye, near the bases of the arms. This species ranges from San Diego to Panama, and perhaps even farther south.

Octopus punctatus GABB.

Octopus punctatus GABB, Proc. California Acad., II., p. 170, 1862.
DALL, Proc. California Acad., III., p. 243, fig. 27 (dentition), 1866.

Plate IV. Plate V. Fig. 2.

Body in preserved specimens more or less ovate, or depressed pyriform, broadly rounded behind and narrowed toward the neck; upper surface of the body and head covered with a soft lubricous integument, which, in the best preserved examples, is strongly and irregularly longitudinally wrinkled, but these wrinkles can be easily smoothed out by the fingers, leaving only slightly thickened, irregular patches and blotches, which are of a darker brown color than the rest of the surface; similar, slightly raised, darker spots, of smaller size, are numerous on the web and outer surface of the arms; at the posterior end of the body the wrinkles are more conspicuous, and often give rise to prominent irregular folds, concentric to the body; these appear to have more persistency than those of the dorsal surface, but as they can be nearly smoothed out, they probably appear and disappear during life, according to the state of contraction of the skin, as modified by the temper of the animal. The entire lower surface is smoother and paler, but shows small, irregular, scattered brown blotches, largest at the sides. The head is of moderate size, with prominent eyes; above each eye are two large, prominent, compressed or angular, soft cirri, blunt at the tip, but not lobed; the most anterior of these is opposite or in advance of the centre of the eye, the other is farther back; around the bases of these cirri, and between them and the eyelids, there are numerous small, unequal, irregular, rounded and compressed warts, which stand somewhat in lines radial to the eye. The siphon is large and long, gradually

tapered. The arms are, in normal specimens, subequal in size, very long, not very stout at base, and very slender toward the tip ; the two lateral pairs are nearly equal, and a little longer than the dorsal ones ; the ventral arms are slightly smaller at base than the others, and about equal in length to the dorsals, or sometimes slightly shorter. The web between the arms is broad and thin ; it is widest between the lateral arms, where it is nearly one fourth as wide as the arms are long, and narrowest between the ventral ones ; between the dorsal arms it is nearly as wide as between the laterals. The web extends as a lateral membrane along the sides of all the arms, but it is widest and extends farthest along the posterior margin of the dorsal and lateral arms and along the anterior margin of the ventrals. Along these margins the membrane can be traced nearly to the ends of the arms. On the anterior sides of the dorsal arms, and on the posterior margins of the ventral ones, the web rapidly narrows, and does not run very far out as a distinct fold, recognizable in preserved specimens. The sucker-bearing face of the arms is not very broad, the breadth of the arms being usually less than the depth, toward the base. The arms are stoutest about opposite the edge of the web, the portion nearer the mouth gradually narrowing. The suckers nearest the mouth are small and elevated, not very close together, alternating, but not standing far out of the median line ; they gradually increase in size, to about the sixteenth or eighteenth, which are within the border of the web, where they attain their full size ; the largest-sized suckers, in the male, continue for some distance beyond the edge of the intermediate web without much change in size ; they are of nearly equal size on the three upper pairs of arms, but somewhat smaller on the ventral ones. Farther out the suckers very gradually diminish in size, becoming very small and very numerous toward the tips. The larger suckers are broad and moderately elevated, with a wide rim and a deep, crenulated central pit, from which strongly marked grooves radiate to the rim. The largest suckers have from 30 to 35 primary grooves that reach the margin of the central pit ; many of these fork once, or even twice, toward the outer margin. The beak is strong and black.

The two large males examined have the third right arm hectocotylized, but not very conspicuously so. A well-marked membranous fold, of moderate breadth, runs from the web along the posterior edge of the arm nearly to the tip ; its inner surface is white and smooth, and naturally curls inward, thus forming a groove, which, at a small, acute, conical papilla, situated at the base of the terminal organ, passes into the furrow of the latter. This organ is relatively small, narrow, rather long, tapering to the tip ; its inner surface is flattened or concave, forming a groove where the margins are incurved. In the best preserved specimens the groove is covered internally, especially near its base, with small, soft, granule-like warts, or papillæ, in about six longitudinal rows, but there are no distinct transverse partitions. The hectocotylized arm, in one of the specimens, had 107 suckers, the distal ones being very small.

The general color of preserved specimens is, as in most species, dull purplish or dark brown on the upper and outer surfaces, paler and more yellowish on

the lower surfaces and on the inside of the arms and web. The color varies much, as in all other cephalopods, according to the mode of preservation, strength of the alcohol, etc. In the best preserved specimens there are irregular, ill-defined blotches and spots of darker purplish brown, often longitudinal in direction, scattered over the upper surfaces of the body, head, and web, and on the sides of the body, beneath. Between these blotches the surface is rather thickly sprinkled with small, dark brown chromatophores.

In life, the color seems to be very changeable. Mr. A. Agassiz has sent me two colored drawings made by him in 1859, from a living specimen taken in the Gulf of Georgia, W. T., and kept in confinement. In one of these drawings the color of the dorsal surface of the body, which is represented as nearly smooth, is purplish red, mottled and streaked with dark brown and with a longitudinal band of brown along the sides, running back from the eyes; the upper and front sides of the web and arms are dull purplish red, irregularly mottled with dark brown; the bases of the ventral arms, with the web between them, and the lower surfaces of the head, have a lighter orange tint. In the other drawing (a side view) the whole surface of the body and head is represented as covered with large and prominent, irregularly wavy folds and ridges, separated by deep wrinkles; the folds are larger posteriorly, but project as irregular warts, both on the back and on the ventral surfaces. The colors of the body and head, in this figure, are dark and rather bright; the upper parts are mottled and streaked with lake-red, dull orange, dark brown, and grayish green, the dark brown and red tints predominating; the lower surfaces are lighter, but similarly mottled, with the orange and lake-red tints most conspicuous; the siphon and edges of the gill-opening are orange-yellow, the latter bordered with dark brown; eyelids brownish red; eyes silvery.

According to the drawings referred to, the body, in life, is swollen and pyriform or ovate, much broader and thicker than the head. In one of the figures there appears to be a membranous fold running along the sides and forming a posterior prominence at the end of the body; in this figure the membranous folds along the sides of the arms are represented as much wider and extending nearer to the ends than in the preserved specimens.

Mr. William H. Dall, who has observed this species in life, furnishes the following notes on its habits: "When angry the horn over the eye is erected, the arms coil together, the eye dilates, and the body quivers with rage. The muscles keep up a squirming motion, but I have never seen any approach to the dark color figured by Chenu as characteristic of the angry *Octopus vulgaris* of the Mediterranean, nor any such elevated longitudinal ridges. The suckers project or are retracted according to the mood of the animal; their outer edge expands when about to seize hold, and contracts after getting hold of anything. In very large individuals the extremities of the arms are long and much attenuated. I suppose they can adjust their shape to their quarters, but when in motion the body is round and always *on top* and the oral disk is invisible. It never willingly turns its mouth up, and when forced to do so clinches its arms, like a fist, over it. With death comes flaccidity and flattening. One with a

body 8 inches in diameter had the arms 16 feet long. They shrank much in alcohol."

Measurements of Octopus punctatus Gabb, in millimeters.

	Nat. Mus., No. 33076 ♂.		M. C. Z., No. 62 ♂.	
Length of body to eye,			229	
From edge of mantle to tip of tail (below),			153	
Breadth of body,			140	
Breadth of head, at eyes,	70		66	
Breadth of head, at base of arms,	82.5		89	
Diameter of eyeball,	25.5		28	
Eye to web between ventral arms,	203			
Eye to web between 3d and 4th arms,	165			
Eye to web between 2d and 3d,	178			
Eye to web between 1st and 2d,	153			
Mouth to edge of web between dorsal arms,	114		165	
Mouth to edge of web between 1st and 2d,	178		216	
Mouth to edge of web between 2d and 3d,	178		216	
Mouth to edge of web between 3d and 4th,	216		229	
Mouth to edge of web between ventral arms,	153		114	
Length of siphon, lower side,	70		106	
Diameter of siphon, near base,	38		33	
Diameter of siphon, at tip,	13		15	
	Right side.	Left side.	Right side.	Left side.
Length of dorsal arms (1st pair),	485	672	915	953
Length of lateral arms (2d pair),	648	699	965	978
Length of lateral arms (3d pair),	533	673	737	965
Length of ventral arms (4th pair),	737	635	838	915
Breadth of 1st pair of arms,	32		25.5	
Breadth of 2d pair of arms,	35.5		25.5	
Breadth of 3d pair of arms,	38		25.5	
Breadth of 4th pair of arms,	32		21.5	
Diameter of largest suckers, 2d and 3d pairs of arms,	20 to 25.5		18	
Diameter of central pit,	6		3	
Diameter of largest suckers on dorsal arms,	19 to 23		18	
Diameter of largest suckers on ventral arms,	19 to 20		15	
Length of terminal organ on hectocotylized arm,	71		71	
Diameter at base,	6		6	

This species has a wide range along the Pacific coast. It extends from San Francisco to Sitka, Alaska. On the coast of Alaska it is smoked and dried by the Indians as an article of food. In the markets of San Francisco it is often sold fresh, to the French and other foreigners, for food.

Octopus bimaculatus Verrill, sp. nov.

Plate V. Figs. 1, 1 a. Plate VI.

Size moderate, body relatively large, elongated pyriform, enlarged posteriorly, somewhat depressed in alcoholic specimens. Upper surface everywhere covered with prominent, unequal, raised warts, usually conspicuous in preserved specimens, except in those which are unusually flaccid, in which they sometimes become low, rounded, or flattened, but do not entirely disappear. On the ventral surface the warts are much smaller and less conspicuous. Head large, not so broad as the body, from which it is separated by a slight constriction ; sides of the head about the eyes prominent. Eyes large. Upper surface and sides of the head conspicuously warted like the body, or more coarsely than the body ; above and a little behind the eyes there is one large, conical, warted cirrus ; in front and around this, above the eye, there are numerous large, prominent warts, some of them larger than those on the general surface. Arms rather long, moderately stout, united at the base for a considerable distance by a strong thick web, the upper surface of which is strongly warted, like the head and body. The web is much more extensive between the dorsal arms than between the ventral ones, usually broadest between the second and third pairs. The lower surface of the web and the sides and ventral surface of the arms are covered with very numerous, crowded, minute, conical or granule-like warts, which often appear to be arranged in small patches or clusters separated by smoother, paler, reticulated lines or wrinkles. Arms unequal, the dorsal pair considerably smaller and shorter than the others. The second and third pairs are very nearly equal in size and length. The fourth pair is a little smaller and shorter, but considerably longer than the dorsal pair. The arms are rounded trapezoidal toward the base, with the sucker-bearing face broad and the dorsal surface well rounded ; the membrane along the sides of the arms in continuation of the web is usually narrow and inconspicuous, and can often be traced only for a short distance. The suckers toward the bases of the arms are large, broad, saucer-shaped, with strong radiating grooves, about thirty in number, and with a large and deep central pit. Margin much expanded, with two borders, the outer one soft and finely crenulated, the inner one divided into lobes by radiating grooves. In some males examined, one sucker within the border of the web is very much larger than any of the others on the second and third pairs of arms. This enlarged sucker is the twelfth from the base, and in the posterior row on each arm. One male of large size has the corresponding sucker only a little larger than the adjacent ones, but the two pairs of lateral arms in the males have ten or twelve suckers (from about the tenth to the twentieth suckers) mostly within and near the edge of the web decidedly larger than the corresponding ones on the dorsal and ventral arms. Beyond the edge of the web the suckers rapidly diminish in size, and on the distal half become relatively small, and gradually decrease to the very small ones which cover the attenuated tips. The large suckers toward the base of

the arms are but little elevated, and have very broad bases ; they alternate regularly, and their borders are nearly or quite in contact. The three suckers next the mouth on each arm are nearly in one line ; the smaller inner ones forming a regular circle around the mouth.

In the male, the right arm of the third pair is hectocotylized. This arm is decidedly shorter than its mate, and tapers much more rapidly to the tip, which is acute; along the posterior dorsal angle of the arm there is a strong, broad membranous fold, with the lower surface strongly concave, white, and crossed by numerous distinct transverse grooves ; the outer edge of the membrane is thin, sharp, white, and curves inward over the groove. The groove with its covering membrane extends close to the tip of the arm, where it terminates in a minute conical papilla; beyond this, there is a minute, conical, naked tip, but without any appearance of the spoon-shaped cavity and transverse grooves found in other species of *Octopus*.

In alcoholic specimens the entire upper surface is usually very dark purplish brown, varying to dark bluish gray. In some specimens there are obscure patches of darker and lighter over the upper surface. In all the specimens examined there is a large, rounded, purplish black spot near the base of the web, and corresponding to the interval between the second and third pairs of arms. Lower surface of the body, head, and web much lighter than the upper surface, dull grayish or yellowish white, finely specked with purplish chromatophores. Terminal portion of the siphon darker, much like the dorsal surface, inner surface of the web and arms grayish purple, paler than the upper surface. Inner surface and rim of the suckers yellowish white.

The largest male observed (from San Diego, Cal.) has the dorsal arms 325 and 390 mm. long, from the mouth; second pair of arms, 540 and 450 mm. long ; third pair of arms on left side, 550 mm.; right (hectocotylized) arm, 400 mm. ; ventral arms, 500 and 490 mm.; greatest transverse diameter of the dorsal arms, 20 mm.; lateral arms, 25 mm.; ventral arms, 20 mm.; diameter of the larger suckers of the lateral arms, 11 to 14 mm.; of the twelfth sucker, 15 to 16 mm.; breadth of the web between dorsal arms, from the mouth, 60 mm.; between lateral arms, 70 to 100 mm.; between ventral arms, 60 mm.; length of body, 70 mm.; greatest breadth, 75 mm.; vertical thickness, 42 mm.; breadth of head across eyes, 45 mm.; breadth of dark spot at base of web, 20 mm.

A somewhat smaller male, with the tissues more contracted, has the dorsal arms 265 mm. long; second pair of arms, 270 mm. (probably reproduced) and 280 mm.; third pair of arms, 300 mm. (left side); hectocotylized arm, 265 mm.; ventral arms, 285 mm.; diameter of the twelfth sucker of the lateral arms, 20 to 22 mm.; of the adjacent suckers, 12 to 14 mm.; length of body, 70 mm.; breadth, 60 mm.; breadth of head, 45 mm.

This species has an extensive southern distribution on the Pacific coast. It is common at San Diego, California, where it has been obtained by Dr. Edward Palmer and others. Numerous small specimens were obtained at Panama and on the coast of San Salvador by Mr. Frank H. Bradley, for the Museum of

Yale College, in 1866 and 1867. The largest specimens that I have seen are two males from San Diego, Cal. These were sent to me for description by the National Museum. They were collected by Prof. D. S. Jordan. A female, of somewhat smaller size, from the same locality, was sent to the museum of Yale College by Dr. Edward Palmer.

New Haven, October, 1883.

EXPLANATION OF PLATES.

PLATE IV.

Fig. 1. *Octopus punctatus* Gabb. Male. Dorsal view, from an alcoholic specimen, somewhat restored. Reduced to one fourth natural size.

PLATE V.

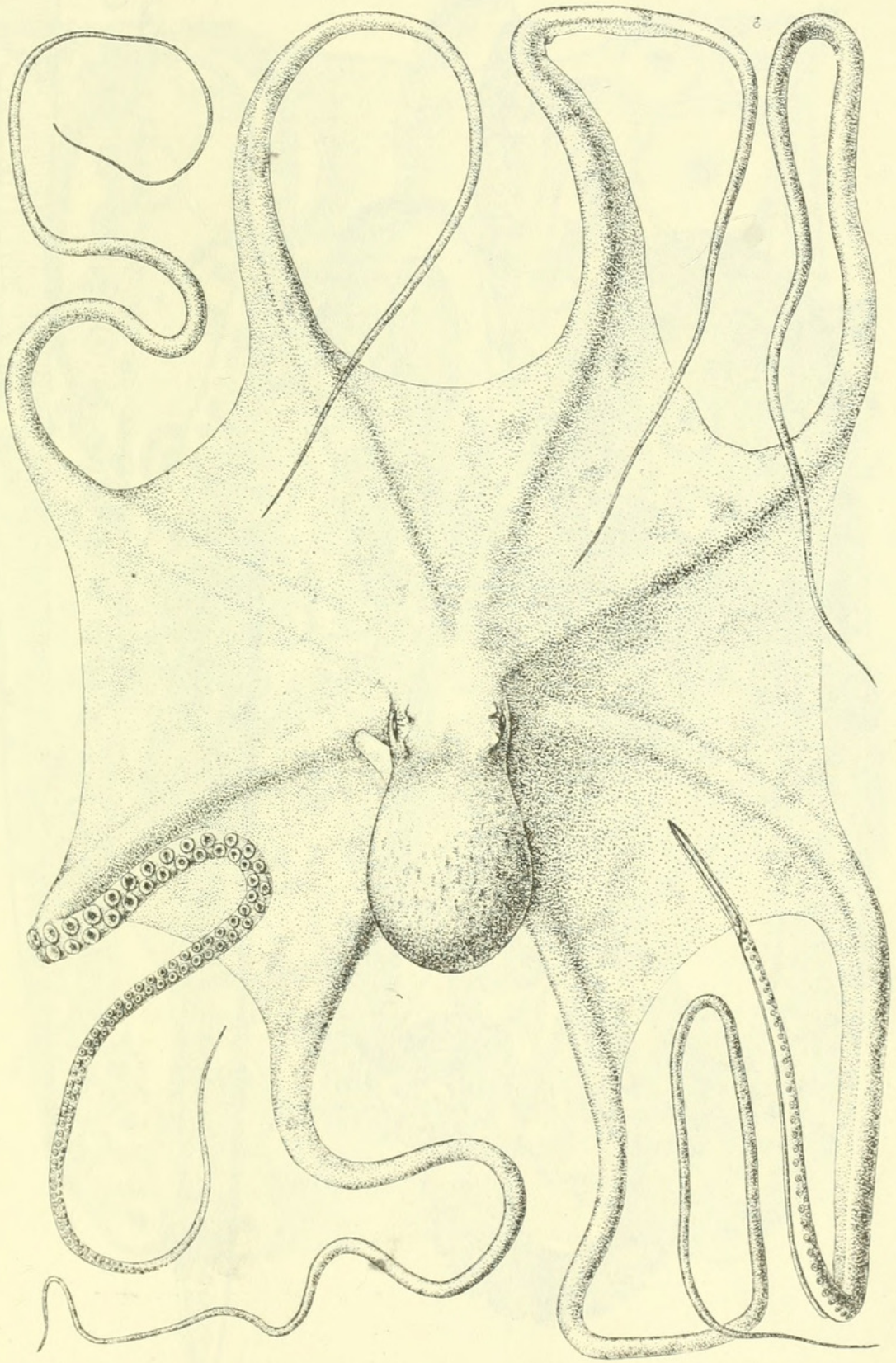
Fig. 1. *Octopus bimaculatus* Verrill. Male. Side view. One half natural size. Somewhat restored from an alcoholic specimen.

" 1 a. The same. Hectocotylized arm. Side view, showing the marginal groove spread open and the very small terminal organ. Enlarged two diameters.

" 2. *Octopus punctatus* Gabb. Distal portion of the hectocotylized arm, front view, showing the terminal organ, spread open, and the commencement of the marginal groove, with a few of the distal suckers. Enlarged two diameters.

PLATE VI.

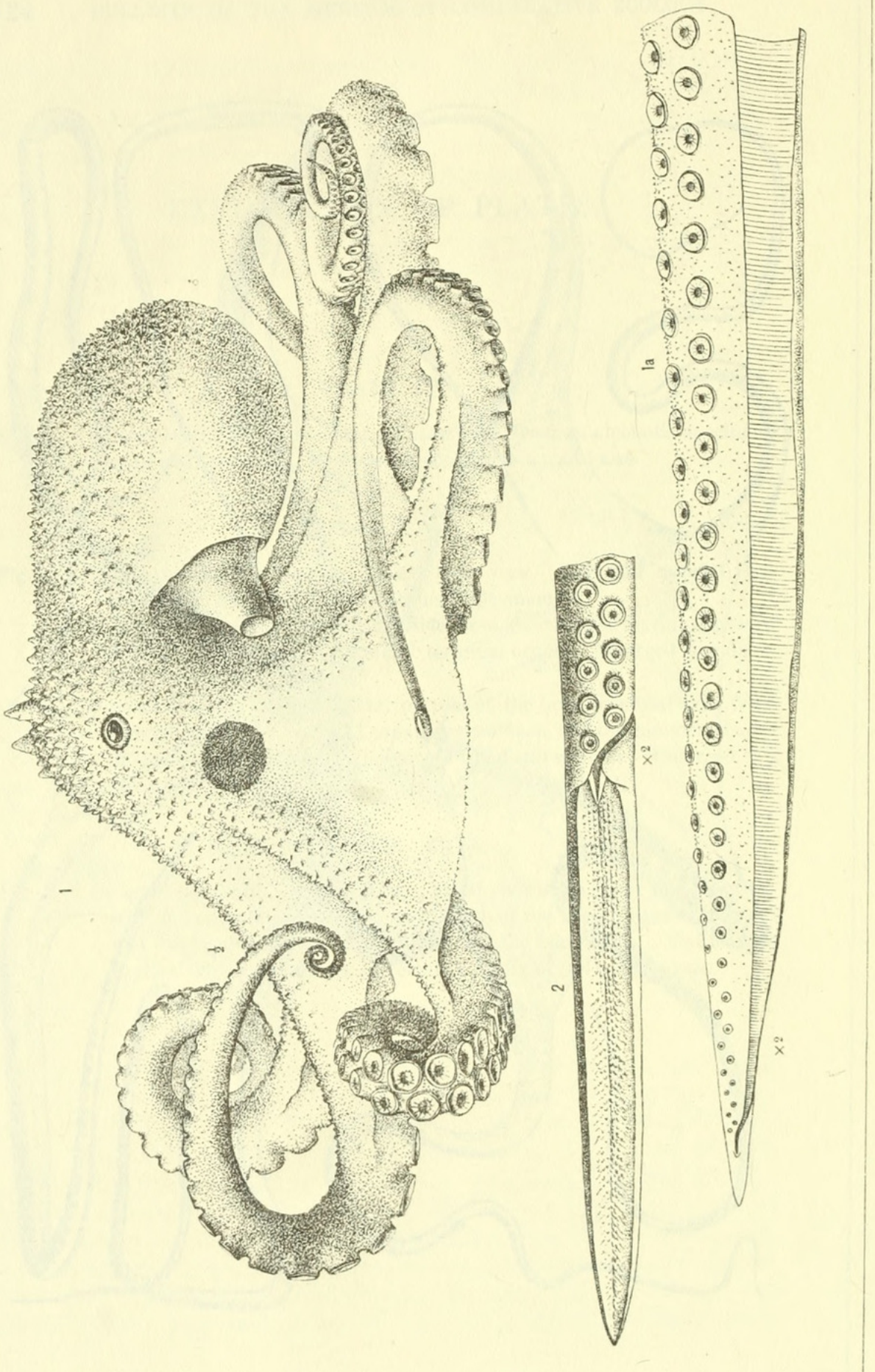
Fig. 1. *Octopus bimaculatus* Verrill. Male. Front view of the inner surface of the web and arms, showing the entire length of the right arm of the second and third pairs, and the basal portion of the other arms. To illustrate particularly the great size of certain suckers of the lateral arms.



J. H. Emerton, from Nature.

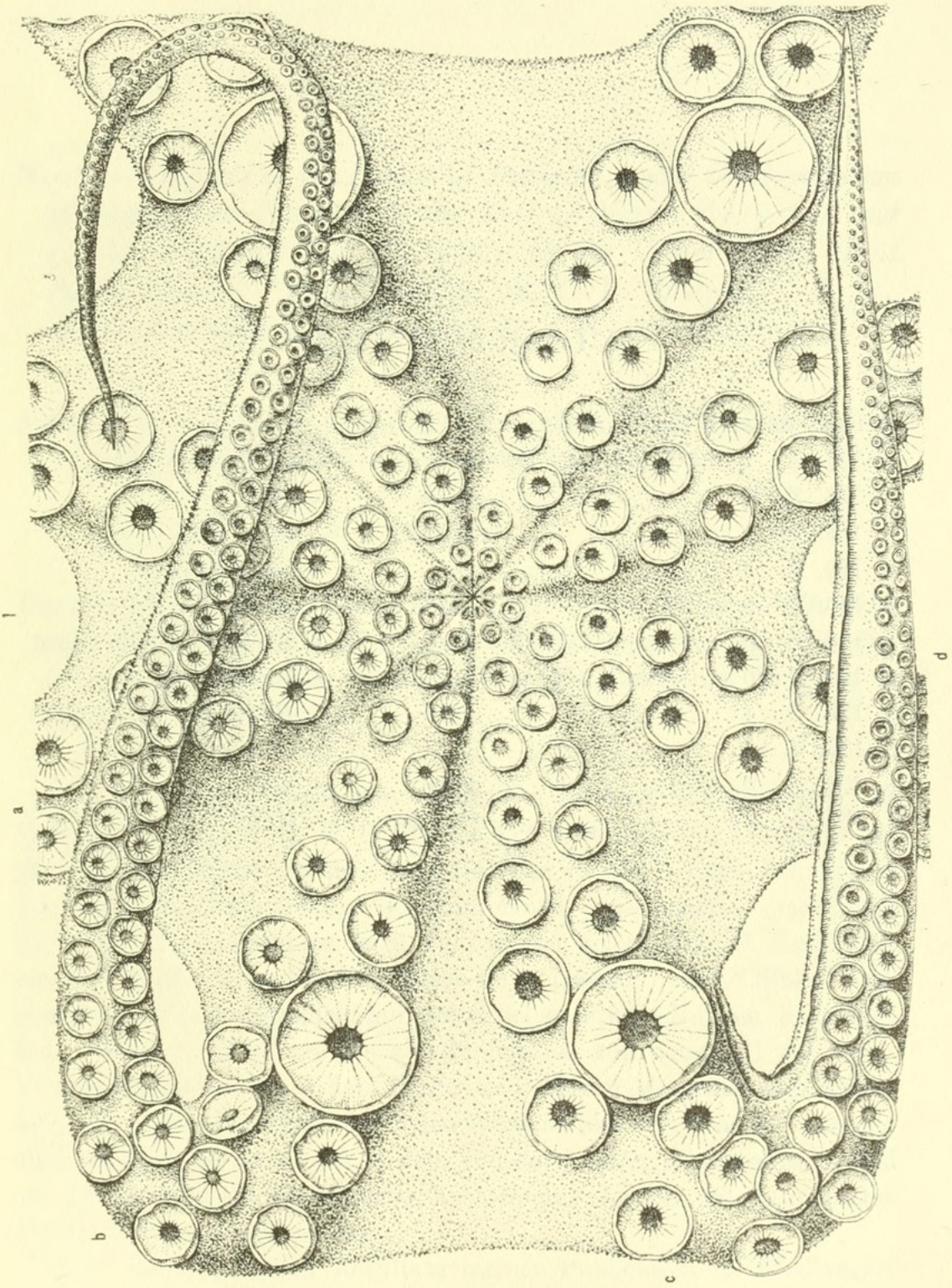
Photo. Lith. by L. S. Punderson, New Haven, Conn.

OCTOPUS PUNCTATUS GABB.



J. H. Emerton, from Nature. Photo. Lith. by L. S. Punderson, New Haven, Conn.

1, OCTOPUS BIMACULATUS 2, OCTOPUS PUNCTATUS



J. H. Emerton, from Nature.

Photo. Lith. by L. S. Punderson, New Haven, Conn.

OCTOPUS BIMACULATUS VERRILL.

CORRIGENDA.

Ueberall lies statt *host* — *Wirth*,

p. 127, Z.	2	von	unten	lies	statt	*T.*	— *P.* Herb. Carpenter,
p. 128, Z.	2	„	„	„	„	*Blake*	— *Bibb*,
p. 129, Z.	1	„	„	„	„	Stat. *23*	— Stat. *203*,
p. 129, Z.	8	„	„	„	„	*der*	— *des* Pharynx,
p. 130, Z.	5	„	„	„	„	*Blake*	— *Bibb*,
p. 130, Z.	10	„	„	„	„	*Blake-*	— *Blake- und Bibb*-Exped.
p. 131, Z.	20	„	oben	„	„	Längs-*Ciste*	— Längs-*Leiste*,
p. 132, Z.	4	„	„	„	„	*Blake*	— *Bibb*,
p. 132, Z.	12	„	„	„	„	„	— *Corvin*,
p. 133, Z.	6	„	„	„	„	*glatt*	— *platt*,
p. 133, Z.	9	„	„	„	„	*bei dem*	— *beiden*.