

PHOTOGENIS SPILOPTERUS Cope.

Trans. Amer. Philos. Soc. Phila. 1866, 280.

Form elongate, less so than in the *Ph. leucops*; scales with the radii distinct 6—10, and the concentric lines very strong. Lateral line deflexed anteriorly. Orbit three and one-half times in length of head, equal length muzzle, and is three-fourths the interorbital breadth. Head five and one-third times in total length, equal length caudal fin. Muzzle straight above, mandible not projecting when closed, end of maxillary attaining line of orbit. Premaxillary margin opposite middle pupil. Pectorals two-thirds length to ventrals. Bases of anal and dorsal fins equal, equal two-thirds height of former, three-fifths height of latter. First dorsal ray a little nearer origin caudal than end muzzle. Rays, D. 1.8. A. 1.8. V. 7 and 8. P. 13.

Length 2.875 inches, depth caudal peduncle at middle .19 in. Teeth in numerous specimens 1.4—4.1.

Color olivaceous, with a plumbeous band along the posterior half the lateral line; thoracic region and lower half the sides of head silvery, remainder of head blackish. Median part of caudal fin, a spot on the upper hinder portion of the dorsal, and a narrow vertebral line, black.

Many specimens of this species are in Museum Academy, from St. Josephs River, in southwestern Michigan.

This species bears a superficial resemblance to the *Hybopsis plumbeolus*, but apart from the difference of dentition, and the spot on the dorsal fin, this species has a smaller eye, longer ventrals, etc.

PHOTOGENIS SCABRICEPS Cope, sp. nov.

This species is readily distinguished from its congeners by its stout robust form, heavy head, and large eye, and in life by minute rugosities which cover the front muzzle and chin, but which disappear, leaving no trace, in spirits.

Front and vertex flat, upper profile plane, end of muzzle obliquely descending. Mouth little oblique, mandible as long as muzzle; extremity of maxillary opposite line of orbit. The operculum is more posteriorly prolonged than in the *P. telescopus*. Lateral line distinctly deflexed. Pins small, pectorals and ventrals short; radii as in the last species.

This species is not so refulgent as most others of the genus. In life it is of a bright sea-green, with an ill-defined silver lateral band, which is leaden shaded on the caudal peduncle. Dorsal streak reddish, scarcely perceptible in alcohol.

Total length 3 in. 1.5 lines; width of cranium behind 4.2 lines; length of caudal fin (equal from end muzzle to preoperculum) 5.75 lines.

This species occurs abundantly in the tributaries of the Kanawha River, in company with the *Ph. leucops*, especially in Sinking Creek, Walker's Creek, and near Austinville. It occurs not rarely in the main channel of the river also.

A Review of the species of the AMBLYSTOMIDÆ.

BY E. D. COPE.

This family is of particular interest among the Urodela, as furnishing connecting forms between the ordinary types of the order, and those larger species which we suppose to be more characteristic of former periods of the earth's history. It also furnishes us with transitional conditions of characters which have been regarded as indicating very diverse origin and nature. The species are mostly of large size, and are probably confined to North America; perhaps a species exists in Japan.

The characters which restrict the family are as follows:

Palatine bones not prolonged over parasphenoid, bearing teeth on their posterior margins.

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Orbitosphenoid separated from proötic by membranous walls. Internal wall of vestibule membranous.

Carpus and tarsus ossified.

Vertebræ amphicælian

Prefrontals and pterygoids present.

Premaxillaries feebly developed, distinct, but not embracing a fontanelle.

Parasphenoid without dentigerous plates.

Parietals and prefrontals prolonged, embracing frontals.

The writer characterized the family as above in the Journal of the Academy, 1866, 105. Dr. Hallowell proposed it in the same work, 1858, 337, but on insufficient characters. Many of the characters of the principal genus, *Amblystoma*, had been already pointed out by Prof. Baird. The genera included by Hallowell were *Amblystoma*, *Xiphonura* Tsch., and *Onychodactylus* Tschudi. Gray had previously embraced the same genera with *Heterotriton* Gray, in his first section of the *Plethodontidæ*, which corresponds with this family. The writer in 1859 embraced *Onychodactylus*, *Amblystoma*, *Camarataxis* Cope, and *Megalobatrachus* Tschudi. In the above cited essay of 1866 the genera are limited to the two first mentioned, with *Ensatina* Gray.

The full investigation of the subject results in the following disposition of these supposed genera, Baird having already shown the identity of *Xiphonura* with *Amblystoma*. *Heterotriton* is identical with *Amblystoma*. *Megalobatrachus*, the great salamander of Japan, I have determined to pertain to the *Protoneuridæ*. *Ensatina* Gray my friend St. George Mivart informs me is identical with *Heredia* Girard. If this be the case, it is established on a species of the *Plethodontidæ*, and one not to be separated from *Plethodon*. I therefore call *H. oregonensis* Girard, *Plethodon ensatus*, and thus we have three species* of this genus in the Pacific district, where none were previously supposed to exist. *Onychodactylus* most probably belongs to the *Plethodontidæ*, the sphenoidal teeth having been perhaps overlooked or lost; but it may be also an exceptional type of the same family. I have not seen it. The character from which it is named, and which has been regarded as part of its generic diagnosis, is probably only a seasonal or incidental one, and not likely to prove even specific. It is a common feature of the large *Amblystomæ*, and has no greater significance with them.

The genus *Camarataxis*, as will appear further on, was established on a larval character, permanent in some individuals, it is true, but not permanent in any species.

On the other hand, there is some probability that one or both of the species of *Hynobius* Tschudi, from Japan, enter the family, but this I am not able to establish.

It is important to observe the significance of the features defining this family. One only, of the eight assigned, is what may be termed a morphic character; the shortened form of the palatine bones, as compared with the posteriorly produced laminae of the *Salamandridæ*, being neither assumed after possession of the latter structure, nor identical with the immature stage of the same, so far as yet known. The two families do not appear, after the brief examination we have given this point, to be developmentally related. The presence of dentigerous plates on the parasphenoid in the *Plethodontidæ* is a character of the same kind.

The embracing of the frontals by the adjacent elements is a developmental feature, being characteristic of the larval condition of various families.

The membranous condition of portions of the walls of the cranium, including that of the vestibule, is a persistence of an immature stage of the *Salamandridæ*.

The biconcave vertebræ constitute a similar persistence of a larval feature.

* See description of *Plethodon intermedius* Baird, and *Plethodon croceatus* Cope, from the West Coast, at the end of this paper.

The presence of pterygoids has the same significance with reference to other families.

The ossification of the carpus, tarsus, and of the premaxillaries, are characters in which this group develops beyond the larval condition which is permanent in the family of Plethodontidæ.

Thus of eight characters two are morphic, and six developmental; of the six, two are of advanced development, and four of repressed development, as compared with other families.

The characteristics of the genus *Amblystoma*, the only one of the family, are as follows:

Palatine series of teeth in the same line, though often interrupted.

Quadratojugal bone wanting.

Tongue attached by its whole base, but with a narrow free margin on all but the posterior portion.

Digits 4—5, free, not connected by natatory membrane.

A stratum of crypts more or less thickened on the parotoid region, and along the superior lateral region of the tail.

A series of mucous pores around the orbit, and for some distance anterior to it.

With respect to the caudal crypts, they are much less developed in the group of which *A. tenebrosus* Baird is the type than in the others.

The larvæ are characterized by the long slender processes of the three branchial laminae, which bear the vascular fimbriae, rather than the laminae themselves, as in some other genera. The internal nostrils are confined between the maxillary series of teeth and the palatine arch, which is concentric with the former and near to it, and is continued backwards on each side, in line with a similar series on the pterygoid bones. A relation of nostrils to palatine teeth similar to the above is permanent in *Amphiuma*, and one intermediate between it and the adult condition of *Amblystomæ* of groups III. and IV. characterizes *Protonopsis*.

The tail and back have a free dermal margin, but there is none on the limbs or digits. The tail is short and deep.

The general anatomy of the larvæ is reserved for the completion of this monograph.

The following are some of the most readily observed characters which are assumed by the *Amblystomæ* at the period of their transformation: 1, the series of teeth on the splenial bone is shed; 2, the carpus and tarsus ossify; 3, the tail narrows and lengthens; 4, the branchiæ disappear; 5, the tongue enlarges, and covers the floor of the mouth; 6, the pterygo-palatine series of teeth becomes more nearly transverse; 7, brightly colored pigment is deposited in the chromatophoræ of the derm. These changes are stated in the order of their occurrence. But in some of the protean species this order is not exactly observed in all individuals, and in consequence of the assumption of one or the other character of maturity in advance of another, the number of species has been supposed to be greater than it is. The same irregularity in the successional appearance of structures is well known in the earlier periods of embryonic life, as stated by Von Baer in the Scholia of his *Entwicklungsgeschichte*. In the chick, different portions of the vertebral axis, and the abdominal plates, may or may not appear in the usual order or succession.

In *Amblystoma* the approximation of the period of reproduction to that of transformation varies with the species, and it is evident that, the closer this approximation under the above principle of variation, the more protean will the species be. As we know from the experiments of Hogg, Duméril and others that metamorphosis is greatly hastened or delayed by the conditions of temperature and light, what would not be the effect, on individuals of such a protean species, of a change of topographical situation, such as the elevation or depression of the land? And I have no hesitation in saying that if the peculiarities of series of individuals of *A. tigrinum* and *A. mavortium*, in the

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respects above enumerated, were permanent, they would characterize those series as species, as completely as any that zoologists are accustomed to recognize. For the evidences on this head, see the discussions of those species below.

The experiments of Hogg above alluded to are as follows, as given by him in the *Annals and Magazine of Natural History*.

He placed a number of impregnated ova of frogs in vessels arranged at regular distances from the light, in a cave. The lessening degrees of light were of course accompanied by a corresponding, but much less rapid decline in temperature. The resulting effects on the metamorphosis may be tabulated as follows :

| | | Mean Fahr. | | | |
|-----|------|-------------------|---------------|---------------|---------------|
| Mo. | Day. | 60° | 56° | 53° | 51° |
| 3 | 11 | Egg | Egg | Egg | Egg |
| | 20 | Larva free. | * | * | * |
| | 25 | * | Larva free. | * | * |
| | 31 | * | * | Larva free. | Larva free. |
| 4 | 10 | Larva very large. | * | * | * |
| | 22 | Metam. complete. | Larva large. | Larva large. | Larva small. |
| 8 | 11 | | Metam. compl. | * | * |
| | 28 | | | Metam. compl. | * |
| 10 | 31 | | | | Metam. compl. |

Other experiments, which will not be quoted now, are equally conclusive as to the effect of light and heat on this process.

The distinction between maturity, or adult age, and complete development, must be borne in mind. The former condition is attained when the ova are fitted for impregnation, and the spermatozooids are capable of accomplishing that result. Development may or may not advance much beyond this period. As one or more periods in the life of every species is characterized by a greater rapidity of development (or metamorphosis) than the remainder, so in proportion to the approximation of such a period to the epoch of maturity or reproduction, is the offspring liable to variation.

The great difference between the different species, and between individuals of the same species in this respect, may be illustrated by the following comparison between the size of the animals at the time of losing the branchiæ, so far as known, and that to which they ultimately attained :

| Species. | Size at loss of branchiæ. | | Average full size. | |
|--------------------------------|---------------------------|----------------------|--------------------|--------|
| | In. | Lines. | In. | Lines. |
| <i>A. jeffersonianum</i> | 1 | 5·75 | 6 | |
| <i>A. punctatum</i> | 1 | 10 | 6 | 6 |
| <i>A. conspersum</i> | 1 | 10·5 | 2 | 7·5 |
| <i>A. opacum</i> | 2 | 2 | 3 | 9·5 |
| <i>A. texense</i> | 2 | 1 | ? | |
| <i>A. microstomum</i> | 2 | 3·5 | 4 | |
| <i>A. talpoideum</i> | 3 | (perhaps too large). | 3 | 9·5 |
| <i>A. paroticum</i> | 3 | 7·5 (not smallest). | 7 | 2·5 |
| <i>A. tigrinum</i> | 3 | 7 to | 8 to 10 | |
| | | 7 | | |
| <i>A. mavortium</i> | 3 | 9·5 to | 8 | 9 |
| | 8 | | | |

In this connection it is desirable to ascertain how far characters distinguishing undoubted species fall into the line of successional changes common to all the species. An answer to this question would solve an important part of the inquiry as to the origin of species. We cannot go into it exhaustively at this time, but direct attention to these characters in the synoptic table. The following are developmental characters which distinguish known species : 1, the direction of the palatine series of teeth ; 2, the length of the body and tail, as 1867.]

compared with the width of the head, is greater in large and old individuals of *A. tigrinum*; 3, the widening of the muzzle and greater separation of the external nares; 4, the spotted, as distinguished from the uniform coloration.

Characters to which no such relation can be assigned: 1, the number of costal folds, whose interspaces correspond with the vertebræ; 2, the number of phalanges.

The complete monography of this genus being reserved for another occasion, the description of the Siredons is not now attempted. Suffice it to say that both Prof. Baird and myself have had evidence, for some time, that some species described by Prof. B. under this name, from our south-western regions, are only undeveloped *Amblystomæ*; and Prof. Duméril, in the Jardin des Plantes, has actually observed the complete metamorphosis of a Mexican species.*

In the following pages little more than a review of the species is attempted. Their clear discrimination has been hitherto a desideratum. Baird, in the first synopsis published, enumerates eight; Gray in 1850 catalogues ten, after we exclude some species of other genera erroneously included. Duméril likewise, including species of other genera, gives five true *Amblystomæ*. Hallowell, 1858, increased the number to sixteen. In the present essay, the species of the family described number nineteen, seven new ones being added. I must here express my acknowledgements to Prof. Baird, who has placed his MSS. notes at my disposal, and which I have adopted whenever they expressed the results of my own observations. Thus the diagnoses of nine of the species, and portions of those of two others, are, with certain modifications, from his pen. The materials on which the essay is based are the unequalled collections of the Smithsonian Institution, which goes beyond all others in the department of Urodela. Probably the second best collection existing, that of the Academy, has also furnished its numerous types, and many little known species, mostly described by the late Dr. Edw. Hallowell.

After the following examination of the transitional features of the species, the value of many of the supposed species heretofore described will be better estimated.

Synopsis of species,

I. Series of teeth along the external fissure of the internal nares. Plicæ of tongue radiating from its posterior portion. Parotoid glands not forming an ovoid distinct mass. Four phalanges in fourth toe.†

A. Costal grooves ten;

α. Vomerine series three.

Head broad, width 3·5 to groin; muzzle contracted. External nares much closer than internal; palatine series convex backwards; tail short, compressed; blackish-brown, grey speckled..... talpoideum.

B. Costal grooves eleven.

α. Vomerine series three.

β. No, or one indistinct plantar tubercle.

Middle series transverse or concave behind posterior margins of nares; width of head in specimens of three inches greater than one-fourth length to groin, in adult, 4·7 times; black above, with gray fasciæ; larger..... opacum.

Teeth as in the last; width of head in small specimens 3·5 to groin, in adults 4·5 times; a strong dorsal groove and longer tail; black above, with a series of round yellow spots on each side the back..... punctatum.

* See a highly interesting account of this event by Prof. Duméril, *Annales des Sciences Naturelles* for 1867, No. iv. p. 229.

† Vide an exception under *A. mavortium* Bd.

Median series of teeth convex, advancing beyond posterior margin nares; width of head much less than one-fourth length to groin; tail short, no dorsal groove; lead colored, with an inferior lateral, and usually superior series of small yellowish spots..... conspersum.

$\beta\beta$. Two distinct plantar tubercles.

Median series of teeth straight, nearly divided; external nares much closer together than internal; width of head more than one-fourth length to groin; muzzle very short; tail much compressed; blackish above, with large irregular yellow spots, confluent on sides; below yellow..... bicolor.

C. Costal grooves twelve; mucous pores on each side the muzzle.

α . Larger species with two distinct plantar tubercles.

β . No canthus rostralis; head longer.

External nares as widely separated as inner; frontal and nasal regions very convex in transverse section; teeth in four distinct series, forming together a V, with concave sides projecting between the nares; body long, tail short; color brown..... obscurum.

External nares nearer together than internal, on account of narrower muzzle; brown, with usually small yellow spots; brown always predominating; teeth continuous, or slightly interrupted externally..... tigrinum.

External nares as widely separated as internal; the muzzle broad obtuse; brown yellow spotted, the yellow spots large, often excluding the ground color; teeth continuous, or slightly interrupted externally..... mavortium.

External nares as widely separated as inner; the muzzle broad obtuse; dark brown, with vertical yellow spots on sides; teeth in four distinct series, in a nearly transverse line..... trisruptum.

$\beta\beta$. Canthus rostralis distinct; tail longer than head and body. Head shorter.

External nares nearer together than internal; muzzle obtuse, head small, width five times to groin; front convex; vomerine teeth in one series slightly convex forwards; yellow, with irregular brown bands above..... xiphias.

$\alpha\alpha$. Smaller species. Teeth in three series. No or one indistinct plantar tubercles.

External and internal nares equidistant; width of head 4.5 to 5 times in length to groin; length of eye 2.5, or a little less in width between anterior canthus of same; tooth series transverse; lead-colored to black, with or without pale or distinct lateral spots..... jeffersonianum.

Inner and outer nares equidistant; width of the long oval head 5.5 to 6 times in length to groin; length eye fissure 1.75 (to? twice) in width between anterior canthus of same; tooth series slightly convex; lead-colored, uniform..... platinenum.

Nares equidistant; width of head 5 times to groin; muzzle contracted; eye fissure 1.66 between anterior canthus of same, once to nostril; median dental series convex forwards. A broad grey band on vertebral line of tail and body, expanding on occiput; sides dark reddish-brown..... macrodactylum

II. Series of teeth extending to external fissure of inner nares; lingual plicæ radiating from behind; parotoid glands forming a distinct ovoid mass.

- a.* Teeth in three series (no canthus rostralis or plantar tubercles); fourth toe with three phalanges.
Nares equidistant, both approximated; median series of teeth nearly straight, short; width head 4.5 times to groin; eye fissure 1.7 times in width between anterior canthus; limbs large, toes short. Uniform brown..... paroticum.
- III. Series of teeth not extending beyond inner line of nares; lingual plicæ radiating from behind; no distinct parotoid mass.
a. Two series of teeth (canthus rostralis distinct); no plantar tubercles; fourth toe with three phalanges; twelve costal furrows (species large).
Vomerine series transverse or directed backwards; muzzle prolonged considerably beyond nares; brown, marbled with dark brown tenebrosum.
Vomerine teeth in two sigmoids, which converge in advance of nares; muzzle shortly rounded from external nares; uniform black..... aterrimum.
aa. Two series of teeth; fourteen costal grooves; fourth digit with four phalanges.
Teeth arched, between inner nares; head one-fourth to groin (in small sp.); eye one-half width between canthus; muzzle broad, outer nearer than inner nares; brown, with a series of lighter spots on upper part of sides; below yellowish; muzzle and tail marbled with the same..... texanum.
- IV. Series of teeth not extending beyond inner margin of nares; lingual plicæ radiating from a median longitudinal furrow of the tongue; no distinct parotoid mass (species small).
a. Two series of teeth (no canthus rostralis); fourth toe with four phalanges.
Mandible shorter than muzzle; head elongate, width between eyes behind equal from same to nares; width of head 6.5 times in length to groin; black, with numerous narrow grey annuli on body and tail..... cingulatum.
Mandible longer than muzzle; head short, broad; width between eyes behind equal from same to end muzzle; body stouter; width of head $6\frac{1}{2}$ to 7 times in length to groin; lead-colored, with a few grey shades below..... microstomum.

AMBLYSTOMA TALPOIDEUM Gray.

Catal. Batr. Grad, Brit. Mus.; Hallowell, J. A. N. Sc. Phil. iii. 351; Baird (?) l. c. i. 288. *Salamandra talpoidea* Holbrook, N. Amer. Herpetology, iii. 117, pl. 29, 1838.

Shortest, stoutest, and most clumsily formed of all the terrestrial *Amblystomata*. Character of skin, as to glands, pits, etc., much as in *A. punctatum* and *opacum*. A row of large pores on the head, interior to the eye and nostrils, extending anterior to the latter; this passes behind and beneath the eye, reaching forward nearly to the nostrils. A patch on the cheeks above the lateral groove, and another below it, probably extending forward along the lower jaw.

The head is very broad, and larger, if anything, wider, than the body; becoming constricted at the neck. Its width is about equal to the distance from snout to gular fold (thus wider than long), and contained about $3\frac{1}{2}$ times to the groin. The eyes are superior, and rather small; separated anteriorly by nearly three lengths of the orbit, about one orbit from the nostrils, which are separated about $1\frac{1}{2}$ orbits. The muzzle is rather angular. The upper jaw is visible beyond the lower, when viewed from below.

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The body is short, squat and depressed; there are ten costal grooves on the side.

The tail is contained about $1\frac{1}{2}$ times in the rest of the animal. It is much as in *A. opacum*, but higher, though without a crest.

The digits are rather long and slender, scarcely different from those of *A. opacum*.

The palatine teeth are in a transverse series of three sections. The middle section is not interrupted along the median line. In the type it is slightly concave anteriorly, scarcely reaching to the under line of the inner nares, and behind the range of the lateral sections, which begin a little interior to the outer line of the nostrils. The middle and lateral sections are separated by the width of the inner nostril. In another specimen the middle patch is nearly straight, in another composed of two arcs concave anteriorly.

The tongue is thick, fleshy and adherent, though the edges are free at the sides; less so at the top. Its width is not more than half that of the head. The papillose portion is separated posteriorly by the extension forward of the plain basal portion of the tongue, although there is no groove, and exhibiting two prominent cornua to the tongue proper. The papillous ridges are longitudinal, and nearly parallel.

In alcohol this species is a light brown above, paler beneath, irregularly sprinkled, blotched and marbled with silvery or plumbeous gray of a lichen-like character. A carefully executed drawing, made from the specimens when alive, shows the ground color to be a dark brownish or liver black, more livid on the sides, and perhaps lighter beneath; everywhere sprinkled with the silvery-grey dots, of larger size, on the back. The upper part of the tail is of a purer brown than elsewhere, and is bordered by a series of obscure blackish spots, seen also near the lower margin; a few similar dusky spots appear scattered on the back. The iris appears to be a dark brown, without metallic lustre.

A series of specimens from Prairie Mer Rouge, La., is quite similar. Some of these appear to have just completed the change from the tadpole state, and the tail is higher, more compressed, and somewhat crested; the toes shorter and flatter; the papillose cornua of the tongue more indistinct.

| | |
|--|------|
| Length from snout to transverse line of mouth..... | ·30 |
| “ “ gular fold..... | ·55 |
| “ “ groin..... | 1·90 |
| “ “ behind anus..... | 2·30 |
| “ “ end of tail..... | 3·80 |
| “ of tail..... | 1·50 |
| Width of head..... | ·52 |
| Length fore arm..... | ·46 |
| “ hind leg from knee..... | ·56 |
| Extent of hind legs..... | 1·70 |
| Greatest height of tail..... | ·31 |
| “ width at same place..... | ·15 |

| Catalogue No. | No. of Spec. | Locality. | From whom received. |
|---------------|--------------|-------------------------|----------------------|
| 3906. | 5 | Liberty Co., Ga., | Dr. Jones, sp. desc. |
| 3879. | 6 | Prairie Mer Rouge, La., | J. Fairie. |
| 3972. | 1 | Near Cairo, Ill., | R. Kennicott. |

AMBLYSTOMA OPACUM Baird.

J. A. N. Sci. Phila., i. 283; Hallowell, l. c., iii. 351. *Salamandra opaca* Gravenhorst, Uebersicht Zool. Syst. 431, 1807; Delic. Mus. Vratislav. i. 75, tab. x. 1829. *S. fasciata* Green, J. A. N. S. i. 350, 1818; Holbrook, N. Amer. Herpetology; Storer, Mass. Rept.; Dekay, Geol. Surv. N. York.

Body swollen, thick, cylindrical, depressed. Skin perfectly smooth, although under a lens everywhere showing minute simple pores or pits connected with
1867.]

the glands, which are seen everywhere in the body and tail, except perhaps in the lower part of sides, belly, and beneath the head; on the tail, however, they are more developed on the upper half. There are no regular patches of more conspicuous pores on the head and parotids, as seen in *A. punctatum*.

Head rather broad, depressed; its greatest width about three-fourths the length from snout to gular fold, and about two-ninths the distance to insertion of hind legs. Length of mouth half that to gular fold, which is interrupted on the nape. A constriction behind the angle of the mouth, with a lateral groove (or ridge) connecting the two, as in *punctatum*. Distance from snout to gular fold not quite three and a half times in that to insertion of hind leg. The eyes are moderate; the pupil circular. The general relation much as in *punctatum*.

Body nearly cylindrical, but decidedly depressed. No indication of a dorsal furrow. Eleven well-marked costal furrows, including the inguinal. There are about four pelvic furrows; those on the base of the tail are distinct for a time, but gradually become fainter.

The tail is oval or elliptical in cross section, though without any indication of a keel. It is nearly cylindrical at base, though slightly compressed; becoming more and more so to the pointed tip. It is thicker above than below, and, measured from beneath the anus, is contained one and a half times in rest of the length. The lateral groove on the tail is less prominent than in *A. punctatum*.

The digits are linear, depressed, but without any indication of web or margin. The third or longest finger is one-third the distance from its tip to the elbow (contained three times); the lateral ones are quite short. The fourth toe is longest; contained two and a half times in the distance from its tip to the knee. The third, fifth, second and first are successively shorter, or the fifth and second are about equal. The distance between the outstretched toes is contained about once and two-sevenths the length from snout to behind anus.

The tongue is thick and fleshy, as in *A. punctatum*, though larger in proportion, and filling the mouth more. The teeth are in one transverse line, in three series, much as in *punctatum*. The central is a double arc. The lateral series are not so far forward, or pass more obliquely backwards, so that their exterior end is even behind the convexity of the central series, not anterior to it. The lateral series is about half the length of the central, with a decided interval.

In alcohol the general color is a livid black. There is a dorsal series of transverse slate-colored bands, which widen at each end into a V on the back, but are more linear on the tail. These vary in number; about seven on the body, and as many on the tail. Sometimes more or less: sometimes confluent with those before and behind them; sometimes interrupted in the middle. They do not descend one-third the depth on the sides, being confined abruptly, and well defined to the dorsal region. There is a similar patch on the snout.

| | | | |
|----------------------|------|------------------------|------|
| Total length..... | 3.80 | Length to tail..... | 2.35 |
| Length of mouth..... | .30 | “ of tail..... | 1.50 |
| “ to gular fold..... | .53 | Width of head..... | .45 |
| “ to fore leg..... | .60 | Length from elbow..... | .45 |
| “ to hind leg..... | 1.90 | “ “ knee..... | .55 |

The principal difference in form and structure between this species and *A. punctatum* are seen in the absence of any dorsal furrow, and a less prominence of that on the side of the tail. The limbs are more feeble, the head narrower, the tail shorter, etc.

In specimens from Prairie Mer Rouge, 4033? the body is thicker and more clumsy, the legs weaker, the toes shorter, than in Pennsylvania specimens. The teeth, too, appear more transverse, and there is little or no interval between the middle and lateral combs.

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| Cat. No. | No. of spec. | Locality. | From whom rec'd. |
|----------|--------------|-----------------------------------|----------------------------|
| 3932 | 15 | Carlisle, Pa. | S. F. Baird. Type of desc. |
| 3940 | 1 | Kemper Co, Miss. | D. C. Lloyd. |
| 4100 | 16 | South Illinois. | R. Kennicott. |
| 3948 | 1 | Tarboro, N. C. | Bridger. |
| 3943 | 1 | Meadville, Pa. | Thickstun. |
| 3964 | 1 | Racine, Wis. | |
| 3924 | 6 | Georgia. | Dr. Le Conte. |
| 3958 | 1 | Aux Plaines R., W. Northfd., Ill. | R. Kennicott. |
| 4008 | 2 | Columbus, Ga. | Dr. Gessner. |
| 3928 | 1 | Anderson, S. C. | Mrs. Daniel. |
| 3927 | 14 | Gloucester, Va. | |
| 3962 | 1 | Ripley, O. | P. Hoy. |
| 3941 | 1 | Abbeville, S. C. | J. B. Barrett. |
| 4085 | 10 | Grand Coteau, La. | St. Charles Coll. |
| 3954 | 4 | Galveston, Texas. | E. B. Andrew. |
| 3953 | 1 | Salem, N. C. | J. T. Lineback. |
| | 3 | Georgia. | Maj. Le Conte. |
| 4007 | 116 | Prairie Mer Rouge, La. | Jas. Fairie. |
| 4920 | 1 | Florida. | Townend Glover. |
| 4018 | 1 | New Orleans. | N. O. Acad. N. S. |
| | 1 | Pearl R., Miss. | R. Kennicott. |

AMBLYSTOMA PUNCTATUM, Baird.

J. Ac. Nat. Sc. Phil. i. 83. Hallowell, l. c. iii. 351. *Lacerta punctata* (1767), L. Syst. Nat. ed. 13, 370, 45. *Salamandra p.* (1802) Lacep. Hist. Quad. Ov. i. 245, 314 (ed. of 1819). *L. maculata* (1802), Shaw, Gen. Zool. Amph. 304. *Salamandra venenosa* (1803?), Bart. in Daud. Hist. Rept. viii. 229 (in lett. from Raf.) *Lacerta subviolacea* (1809), Bart. Am. Phil. Trans. O. S. vi. p. 108, pl. 4 fig. vi. *S. subv.*, DeKay (1842), N. Y. Rept. 74, pl. 2, f. 36. *S. venenosa* (1838), Holb. Herp. 1st ed. iii. 105, pl. 24 (1842), 2d ed. v. 67, pl. 22. *Amblystoma subviolaceum*, Tschudi.

Body swollen, stout, cylindrical. Head depressed. Skin smooth though pitted with pores, most numerous on the tail. Of these there is a patch larger over on the parotid region, and another on the top of the head inside of the orbit and extending anteriorly in a straight line towards the nostrils, and passing backwards semicircularly behind the eye; a double row round the edge of the lower jaw; a pair on each intercostal space along the side of the body, and a row on each side of the top of the tail; the latter indicated generally by a whitish dot.

Head broad, depressed; width nearly equal to distance from snout to gular fold, and nearly one-fourth the distance to insertion of hind legs. Length of mouth, along axis of body, nearly distance from snout to gular fold, which is nearly continuous across the nape. There is a convolution behind the angle of the jaws, interrupted above and below, and a furrow connecting the two along the parotid region, and extended in a lateral line to the orbit. Distance from snout to gular fold contained $3\frac{1}{2}$ times in distance to insertion of hind lip; (four times in another specimen).

The eyes are moderately large; the length of the orbit contained $4\frac{1}{2}$ times in distance from snout to gular fold; about once in distance from the nostrils and about once in the distance between the two nostrils; nearly twice in distance between the anterior extremities of the orbits.

Body nearly cylindrical; perhaps slightly depressed, and swollen a little in the middle. On each side are eleven costal grooves, including unguinal and axillary ones, strongly marked, and nearly continuous above and below. The axillary is, however, quite inconspicuous. Four more of these furrows to behind the anus, where the last is confluent with the first caudal furrow.

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These become less and less distinct to near the middle of the tail. There is a slight groove down the middle of the back.

The tail is oval in section, the larger end of the oval below; becoming more and more compressed to the tip, without indication of any ridge. There is a lateral indentation along the whole length, which is about equal to the distance from its back to the snout. In alcoholic specimens the tail is bent or curved, sometimes upwards, sometimes down, sometimes laterally.

The digits are nearly cylindrical, or slightly depressed, without web or margin. The third or longest finger is contained about $2\frac{1}{2}$ times in the distance to the elbow. The second finger reaches to the last articulation; the fourth to the penultimate.

The fourth toe is largest, contained $2\frac{1}{2}$ times in the distance to the knee; the 3d, 2d, 5th and 1st successively shorter. The distance between the outstretched hind toes is rather more than one and one-third the length to behind anus.

The tongue is thick, fleshy and attached, although free at the edges, except behind. It is about two-thirds the width of the upper jaw, nearly orbicular, though the outline of the papillose portion is a little emarginate behind. It almost seems as if the tongue were capable of closing round an object in its centre as in the hollow of the hand.

The transverse line of teeth is in the parts or combs; a central about two-fifths the width of the head, and separated from the lateral by a slight interval. The central patch is nearly straight in its middle, but the end curves a little forwards, and continuously with the lateral portion of the line, from a curve concave backwards, bounding the orbit. The inner edge of the posterior nares marks the extent of the central row of teeth. The lateral combs of teeth are about half the central.

The color of the specimen described is, in alcohol, of a dark liver brown above, abruptly light olivaceous beneath. On each side of the back is a series of nearly circular rounded spots, about the size of the orbit; about three on each side of the head, 8 or 9 on the body, and as many on the tail, where they are sometimes confluent. These spots are white in alcohol, but yellow in life. Along the sides, and more sparingly beneath, are some scattered quite small whitish spots, not very conspicuous. The legs are of the color of the under parts, not of the upper. They show some of the small light spots seen on the sides.

| | | | |
|------------------------------|------|-------------------------|------|
| Total length of 3950 (1).... | 6.50 | Tail, behind anus..... | 3.10 |
| “ mouth..... | .40 | Width of head..... | .65 |
| “ to gular fold..... | .82 | Arm from elbow..... | .60 |
| “ groin..... | 2.80 | Hind leg from knee..... | .80 |
| “ behind anus... | 3.40 | | |


In the preceding paragraph I have described a specimen from Abbeville, S. C., as a locality nearest to that whence the original of Linnæus' description was obtained. An examination of a large series of specimens from different localities shows certain differences which, however, are not of a character to indicate specific separation. Carlisle specimens have longer and more cylindrical toes than those from Louisiana.

The external appearance of the skin varies considerably with the strength of alcohol used for preservation, and probably with the season when captured. The animal when alive is perfectly smooth and lustrous, and readily exudes a large quantity of a white milky juice from the upper half of head, body and tail, or from the dark colored portion. This is due to the presence of glands closely implanted in the skin, the pores of which are sometimes quite inconspicuous, sometimes very distinct. On the tail they are much largest and deepest, and the lateral groove marks their inferior boundary, being there implanted vertically. When these pores are very full of their milky juice, and the alcohol is very strong, the contraction of the skin between the mouths of these pores gives more or less the appearance of rounded, thick-set granules,

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of rather large size. This also gives rise to an apparent depression of the digits, the skin forming quite a margin.

The proportions of the body vary slightly. The tail is generally not so long as the rest of the animal, the groin being more usually nearer the middle point of the axis. Younger specimens appear to have shorter tails.

There is considerable diversity in the curve of the transverse series of palatine teeth. In nearly all more northern specimens the central row is formed of two arcs, concave anteriorly , more or less continuous with the lateral, which are anterior and convex anteriorly. The two central arcs are continuous at their inner ends, forming an inverted angle at the axial line. Sometimes, however, as in most of the specimens from Prairie Mer Rouge, this central angle is wanting, and there is only a single arc or curve, concave anteriorly. In the type specimen described the central row of teeth is nearly or quite straight (which is quite apt to be the case in very large ones), while in one specimen of No. 4684 it is convex anteriorly. The transverse extent of this middle line of teeth varies. Sometimes there is quite an interval between it and the lateral, while in 3930, from New York, they are continuous, without appreciable interruption.

There are no very great variations in the pattern of coloration; generally the outer surface of the limbs is colored like the back, in which case there are one or more large rounded light spots. The under parts are generally dark-bluish; the sprinkling of small white specks on the sides and beneath varies considerably in prominence. The large dorsal spots are always nearly circular, and vary in number; generally only one series on each side.

In living specimens from Carlisle, Pa., the iris is dark brown, without metallic color, scarcely distinguishable from the pupil. The color of the animal above is a deep anthracite black, beneath dull livid. On each side the dorsal line is a series of large, nearly circular, gamboge yellow spots, somewhat symmetrically disposed. These vary from 10 to 20 from head to tail, and sometimes are larger than the eye, usually about its size. On the sides and beneath are sparingly scattered small bluish-white specks. The spots, both yellow and bluish-white, are sometimes found on the legs.

In younger individuals the yellow spots are brighter, and the black ground deeper.

| Cat. No. | No. of Spec. | Locality. | From whom received. |
|----------|--------------|-------------------------------|------------------------------|
| 3950 | 6 ♂ | Abbeville, S. C. | J. B. Barrett (spec. descr.) |
| 3936 | 1 | Quebec. | R. Nettle. |
| 4084 | 2 | Grand Coteau, La. | St. Charles Coll. |
| 3925 | 2 | St. Louis, Mo. | Dr. G. Engelman. |
| | 2 | Lake Superior. | J. H. Slack. |
| 3944 | 1 | Centre Co., Penn. | S. Brugger. |
| 3961 | 3 | Somerville, N. Y. | |
| 3938 | 7 | Root River, Racine, Wis. | Prof. Baird. |
| 4686 | 1 | Cleveland, O. | Dr. Kirtland. |
| 3963 | 6 | Meadville, Pa. | |
| | 1 | Halifax, N. S. | Dr. Gilper. |
| 4077 | 2 | Fort Towson, Red R., Ark. | Dr. L. A. Edwards. |
| 3942 | 3 | Knoxville, Tenn. | Prof. Mitchell. |
| 3929 | 2 | Westport, N. Y. | S. F. Baird. |
| 3930 | 2 | Alleghany Co., N. Y. | Dr. Stevens. |
| 3926 | 6 | Carlisle, Pa. | Prof. S. F. Baird. |
| 4086 | 2 | Virginia. | W. McDonnald. |
| 3786 | 1 | Cleveland, Ohio. | Dr. Kirtland. |
| 3905 | 62 | Prairie Mer-Rouge, La. | Jas. Fairie. |
| 4098 | 41 | W. Northfield, Cook Co., Ill. | R. Kennicott. |

AMBLYSTOMA CONSPERSUM Cope.

Proceed. Acad. Nat. Sci. Phila. 1859, 123.

This is one of the smallest species of the genus, and though less stout than 1867.]

the two preceding, is more so than the *A. jeffersonianum*, which it resembles in general features.

Skin everywhere smooth. In some specimens only a series of pores may be traced along the superciliary region, and in a line to near the nostrils: several are on the parotoid region. The skin of the body is remarkably free from visible pores, while, as usual, the superior part of the tail is thickly studded with them.

The head is a broad oval, its width entering the length to the groin 4.5 times or a little more, and is a little over three-fourths distance to gular fold. Eye fissure equal to nostril and 1.75 between anterior angles, and a little more than distance between nostrils. The last distance is a little less than that between inner nares. Posterior canthus of eye a little anterior to canthus oris, anterior canthus opposite middle of upper lip from anterior point. Muzzle longer than chin.

Furrows behind the orbit inconspicuous, but present. Costal grooves eleven. Tail short, everywhere compressed, measuring from its origin (at end vent) to axilla or to gular fold. No marked dorsal groove.

The limbs are short, the digits long and slender. When appressed the fingers reach to the keel or beyond bases of fingers. Digits subcylindrical, anteriorly 3d longest, then 2, 4, 1; posteriorly 4, 3, 2, 5, 1. Two small tubercles on edges of sole. Expanse of outer toes equal from end muzzle to posterior canthus eye.

Teeth in three patches, the median longest, commencing opposite inner margin nares and convex to between nares or nearly so in one specimen. Tongue longer than broad, the laminar portion prolonged in two lateral bands posteriorly.

| | Lines. |
|--------------------------------------|--------|
| Length from snout to gular fold..... | 4.50 |
| “ “ groin..... | 16.25 |
| “ “ end anus..... | 19.3 |
| “ “ end tail..... | 31.9 |
| “ of mouth on median line..... | 3. |
| “ fore arm and hand from elbow | 3. |
| “ leg and foot from knee. | 5. |
| Width of head..... | 3.7 |

General color above leaden, below pale leaden, the latter usually bounded by the line of the limbs, but in one specimen rising as high as the line of the eye. Lower parts of sides and sides of tail more or less varied with small whitish spots, the former often in a regular line. A similar line on the upper part of the sides is present in some specimens, in others wanting. The end of the muzzle is sometimes pale marbled.

Eight specimens of this species before me confirm its validity in every respect. Specimens of the developed young of both *A. opacum* and *A. punctatum* are of considerably smaller size, and maintain their peculiar colorations, and a greater width of the head, etc.

From the appended localities from which it has been sent, the range is seen to be extensive:

| <i>Mus. Smithsonian.</i> | | | |
|--------------------------|-----------|-------------------|----------------|
| No. | No. Spec. | Locality. | Donors. |
| 3934 | 3 | Carlisle, Pa. | S. F. Baird. |
| 3918 | 1 | “ | “ |
| <i>Mus. Academy.</i> | | | |
| | 1 | Charleston, S. C. | Dr. Hallowell. |
| (Spec. descr.) | 2 | Liberty Co., Ga. | John Le Conte. |
| (Type) | 1 | Chester Co., Pa. | E. D. Cope. |

AMBLYSTOMA BICOLOR, Hallowell.

Proceedings Acad. Nat. Sci. 1857, 215.

In the type specimen of this species, the usual supraorbital and lateral

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frontal series of large pores are not discernible. In a second specimen they are well marked. In the former the skin is quite smooth, with eleven lateral grooves, and the folds of the throat and side of the head not strongly marked. The head is broad and obtuse, entering the length to the groin 3.75 times. The front convex is profile, containing the length of the fissure of the eye in its width between anterior canthus of same 2.75 times. The same measure is a trifle less than distance from same to nostril, and one and a quarter the distance between the latter. These are much closer together than the inner nares. Distance between outer margin of nares equal length from end muzzle to mid-interorbital space.

Dorsal line with a faint groove. Tail much compressed, equal from end vent to canthus oris. Body stout and heavy. The limbs are stout and the digits not elongate and depressed. The appressed limbs overlap by the length of the toes. Two well marked palmar tubercles. Third and fourth toes nearly equal, fifth a little longer than first.

Tongue large, disciform, not emarginate behind; palatine teeth in three entirely transverse series, the interruption taking place considerably inside the line of the nares. The teeth themselves are in numerous rows on each of their bony crests, presenting a brush-like arrangement. Medium series notched behind.

| | In. | Lines. |
|---|-----|--------|
| Length from end muzzle to gular fold..... | | 9.75 |
| “ “ to groin..... | 2 | 7.2 |
| “ “ to end vent..... | 3 | 2.3 |
| “ “ to end tail..... | 5 | 10.05 |
| “ of mouth (straight)..... | | 6.1 |
| “ forearm and foot | | 6.75 |
| “ lower leg and foot | | 8.8 |
| Width of head..... | | 8.75 |

Color above olive brown, below yellowish, olive shaded in the middle. The inferior yellow rises on the sides as short blotches; above them are several ill-defined yellowish spots. Parotid region yellow, with a distinct black vertical bar. Limbs brown cross banded; tail yellow with brown spots.

The above description is taken from the type from Beesley's Point, N. Jersey, in Mus. Academy. Another specimen, 4692, from the same locality, in Mus. Smithsonian, differs in two important particulars; the palatine teeth are not brush-like, but are confined to the crest of the ridge, and the tail is a little longer than the head and body. The muzzle is rather longer and the mucous pores more numerous. It may belong to another species, as the *A. tigrinum*, which it much resembles, but its eleven costal folds are a notable peculiarity. The *A. bicolor*, though nearest the *tigrinum*, appears distinct, after a careful scrutiny of many individuals of the latter.

AMBLYSTOMA TIGRINUM, Baird.

Journ. Ac. Nat. Sci., Phila., i. 284. *Salamandra tigrina* Green, v. 116, 1825. *Triton tigrinus* Holb., N. Amer. Herp. 1842, 579, DeKay, Nat. Hist. New York. *Salamandra lurida* Sager, Am. Journ. A. S. 1839, 322. *Amblystoma luridum* Baird, J. A. N. S. i. 284, Hallowell, l. c. iii. 383. *Amblystoma episcopus* Baird, l. c. 292, Hallowell, J. A. N. S. iii. 354. *Salamandra ingens* Green, l. c. 1831, 254. *Amblystoma* Hallow. *Heterotriton* Gray.

General form very thick and massive, although the head is proportionally small in mature specimens; not as broad as the body. The skin appears quite smooth when fresh, especially when covered with its epidermis. On removing this, however, the skin is seen everywhere closely covered with shallow pits, interspersed with granule-like projections of the glands. There is an indistinct line of pores on each side of the head interior to the eye, but they can scarcely be traced elsewhere.

The parotid region is much swollen, wider than the skull, and about equal
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the distance from snout to gular fold. The width of the jaws is contained about $4\frac{1}{2}$ times in the distance to the groin, a little more than five to the end of the anus. The gular fold is very distinct and even overlapping. Over behind the jaws and from the eye, obliquely along the side of the head and neck, are also very strongly marked.

The eyes are moderate, not prominent; the pupil similar. They are distant from the nostrils one orbit length; separated anteriorly $2\frac{1}{2}$ orbits. The nostrils are separated one orbit. There is a decided constriction at the neck.

The body is swollen and large; a little depressed at its circumference, at the widest is nine-tenths the distance from snout to groin. There are twelve well marked costal furrows, from fore to hind leg; five pelvic; the 4th and 5th uniting just behind the anus.

The tail is about equal to the distance from snout to groin; it is subquadrate at base; $1\frac{1}{3}$ as high as wide, but becomes immediately oval in section, larger below, and more and more compressed to the tip. The edges are, however, rounded to the terminal third, where they gradually become sharp.

The legs are stout, thickened and rather short in proportion. The digits are much depressed; short, triangular in shape, tapering from the broad base to the tip, which are hardened and somewhat horny in appearance. The free portion of the longest is about one-third the total length of the limb from elbow to knee; sometimes even less. In the individuals which live on land, the digits appear longer and more cylindrical. The expanse of the outstretched toes is about four-fifths the distance from snout to groin.

The tongue is fleshy, broad, about half the width of the head, and with the outline of the papillose portion slightly emarginate behind.

The palatine teeth of this species extend across the palate very nearly from one side of the upper jaw bone to the other. The series is only interrupted along the median line; sometimes scarcely so. The line is obtusely angularly rounded anteriorly, the concavity behind reaching forward to about opposite the middle of the internal nares. The slightly convex anterior branches diverge backwards regularly nearly to the line of the inner nares, where the angle of divergence becomes still greater, and the line becomes nearly straight, or even concave, anteriorly.

There are considerable variations in the outline of the curve of palatine teeth, as will be given below.

In alcohol this species is of a dark livid blackish brown, paler beneath. On the upper surface, generally on the side of the tail and limbs, are nearly circular yellow spots, about the size of the eye, and generally sharply defined. These are much like those of *A. punctatum*, though not quite so distinct, and although a faint indication of arrangement in ten dorsal rows may be traced, yet these are less symmetrically disposed, and single ones are scattered between the others along the back. Similar scattered spots are seen along the belly, which again is bordered, as on the lower part of the sides, with larger, more quadrate spots, which are more or less confluent, giving rise to elongated blotches, overpowering the ground color. This is also sometimes the case on the belly, and almost always on the chin, or beneath the head and neck.

The rounded spots above sometimes vary considerably in size, and occasionally are almost wanting. Sometimes they are more or less confluent, in which case there is usually a predominance of yellow on the belly. In a large series of specimens, I have not observed any vertical yellow bands on the side of the tail.

In the young just perfected from the larva the upper parts are dark brown, the under parts uniform, of a brownish yellow apparently. The yellow spots next make their appearance, becoming more and more prominent to a certain age. In very old specimens the dorsal spots become indistinct, but may generally be discovered when held under water or alcohol.

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Dimensions of 4691.

| | |
|--|------|
| From snout along axial line to end of mouth..... | ·55 |
| “ “ “ gular fold..... | 1·00 |
| “ “ “ groin..... | 3·50 |
| “ “ “ end of anus..... | 4·40 |
| “ “ “ “ tail..... | 8·00 |
| Width of head..... | ·80 |
| Fore arm from elbow..... | ·80 |
| Hind leg from knee..... | 1·10 |

The largest specimen before me measures ten inches (4003, Racine). In this the tail from behind anus is as long as the rest of the animal. DeKay describes one of eleven inches in length.

Measurement of a typical specimen of the var. *tigrinum*.

| | |
|---|------|
| 4692. (1.) Length from snout to end of mouth along median line..... | ·45 |
| “ “ “ gular fold..... | ·90 |
| “ “ “ groin..... | 3·10 |
| “ “ “ behind anus..... | 3·75 |
| “ “ “ tip of tail..... | 7·55 |
| “ of tail..... | 3·80 |
| Width of head..... | ·70 |
| Fore arm from elbow..... | ·75 |
| Hind leg from knee..... | ·95 |
| Greatest height of tail..... | ·65 |
| Stretch of hind legs..... | 2·80 |

In this variety the most appreciable difference in color consists in the tendency to transverse or vertical bars of yellowish on the side of the tail more or less confluent.

I find no difference in form between the two series of the supposed *A. episcopum* now at hand, 3899 and 3887, and young specimens of *A. luridum*, as 3971, from Marietta, Ohio. The color above is light reddish brown, the sides a sharply defined dusky brown; the belly of a lighter shade of the color of the back. There are some very obsolete indications of whitish spots in the belly and sides. I am by no means convinced that these are not light colored varieties of *A. luridum*. I have, however, not been able to find the original specimen.

The following examination of the nature of the variation to which this species is subject, and their causes, may be added to the preceding diagnosis from Baird's MS.

The color varieties are as follows:

α. Uniform brown above, yellow below, sides darker brown; 3887, 3899, three specimens.

β. Blackish brown, with small scattered yellow spots above, and large ones on the sides; the majority of the individuals; Nos. 4003, 4097, 4691, 3974, 3895, 3966, 3983, 3970, 3950, 2971, 4692, 4706, and eight in Mus. Academy.

γ. Nearly equally and not coarsely marbled above with blotches of deep brown and bright yellow; 4059.

δ. Entirely yellow, with brown linear patches irregularly arranged; type of *A. ingens* from New Orleans; one specimen.

The above coloration varieties, it will be observed, coincide in part with those of *A. mavortium*.

The conditions of preservation of immature stages in the dentition are as follows:

A. Palatine series nearly entirely transverse behind the internal nares; eight specimens, all from New Jersey, except two from Root River, Wisconsin, 4093, and one from Louisiana, 4706. All are fully developed, and many of the largest size; one of 4093 has the postnarial dental series separated on one

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side. Of these, the largest example of the species is from Root river; with the other mentioned, the width of the head enters the length of the groin 4.5 times; and the tail is longer than head and body; the same relations are seen in two New Jersey specimens. Two from the latter State have the long tail, but the width of the head is only one-fourth length to groin, while one of the same have the longer body (4.5 times) but the tail shorter than head and body; two specimens have both the short body and tail. The elongation of the tail and body scarcely occurs in connection with any other type of dentition, and it is mentioned here to show the greater general completeness of development in these Eastern individuals.

B. Series slightly arched, not passing between nares. Two specimens large. In No. 3993 both outer segments are well separated from the median; the tail is longer than head and body, and width of jaws 4.33 to line of groin; this individual is aberrant.

C. Series angulated, not extending anterior to anterior margin inner nares; Nos. 3956, 2971, 3983, 3895, 3899a, embracing five specimens. Three large sp. in Academy Mus. and type of *A. ingens* Green in same.

This last specimen is peculiar in some respects, as already noted in coloration. The head is relatively a little wider than in other specimens of the same large size, the width entering the length to the groin four times, as in individuals of the smaller average size of the species. The length of the eye fissure enters 2.5 times the interorbital width, instead of twice, though in one of equal size from Root River it enters 2.2 times. The nares are not more than usually separated, hence the muzzle is more contracted than usual; it is also depressed in profile, but not more than in some other specimens. I believe it not to be a distinct species, but a form dependent on causes similar to those producing others here enumerated, and not more permanent than these so long as those causes are not universal. In other words, it is a large specimen with teeth, head and tail of adult character, but body and muzzle more larval. The fold on the hind leg and outer toe, mentioned by Green, is not marked, or different from that seen in the species generally.

No. 4097, sixteen specimens from W. Illinois, two have the series divided into four; 4093, two sp.; No. 4691, Cook Co., Ill., thirty-four specimens, one has the three interruptions, and five, with one of 4093, a median, making two series of teeth.

Of series C, the tongue is of normal size and the branchiæ absorbed, except in twelve specimens, No. 4691, of which five present stumps of the branchiæ; and two, 4097, where both the tongue is very small and the gill stumps remain. The width of the head is .25 to groin, and the tail never longer than head and body.

D. Median series arched, extending anterior to anterior margin of inner nares. One specimen, 3966, is fully developed in all other points.

E. Palatine series angulated, extending anterior to inner nares' anterior border. Nos. 4057, 3974, 3070, two of 4093, 3887, 3897b, four of 4097, nine of 4691. All of these have the short head and tail given in the preliminary diagnosis. The small or larval tongue occurs in one of 4093, 3070, 3974, nine of 4691, two of 4097; branchial rudiments remain in two of 4097, and nine of 4691. No. 4057 is remarkable in having a very small tongue and short deep tail, no stumps of branchiæ, and brilliant coloration, with large size and general adult appearance. It compares with certain specimens (4693, 3984), of *A. mavoritum* in this strong retention of some larval characters, and like them is from northern Minnesota, a region noted for its cold and late seasons.

Measurements of No. 4057.

| | |
|---|------|
| Length of snout to end of gape of mouth | ·55 |
| " " gular fold | 1·00 |
| " " groin | 3·50 |
| " " behind anus | 4·30 |

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| | |
|---|------|
| Length of snout to end of tail (about)..... | 8.55 |
| " of tail about..... | 4.25 |
| Depth of tail (at end vent)..... | 1.95 |
| Width of head..... | 1.00 |
| Fore arm from elbow..... | .90 |
| Hind leg from knee..... | 1.10 |
| Stretch of hind leg..... | 3.40 |

A specimen entirely similar except in size and coloration, was found by Dr. Horn, near Beesley's Pt., New Jersey, a well known locality for the species. The tail is remarkably thick and deep at the base, and only equal from its basis to the canthus of mouth. A groove in the dorsal line behind, tail not grooved. The color is a dark leaden brown, sprinkled everywhere with small yellow spots; spots large, on tail; belly yellowish. Total length 6 in. 5 l.

From the preceding investigation we gather that larval characters in this species are in part only cotemporaneous; that the branchiæ are lost first, the tongue develops next and the teeth last. That the development extends in older age to the lengthening of the body and tail. That the progress may be arrested at a time when different degrees of combination of these and other features exist. That reproduction may take place at any of such different stages, is evident from the condition of development of the ova of many of the various specimens; and it is known to take place in other species at earlier stages than any recorded here as adult.

It is also to be noted that specimens from New Jersey are almost always more fully developed than those from the western regions; the former is a warmer district than the latter. Of two specimens from New Orleans, however, one only exhibits the dentitional characters of the New Jersey individuals. The characters common to the western individuals have occasioned the opinion that it was another species, which was called *A. luridum*.

Axolotls, or reproducing *Amblystoma* larvæ from Mexico, have recently reproduced in the Garden of Plants, as before stated, and the offspring have lost most of their larval features remarkably early. Prof. Duméril finds the teeth of these specimens to resemble those of the supposed *A. luridum*, and adds that they may belong to that species. This is not probable from the habitat. The *A. mavortium* extends into Northern Mexico, as far as the limits of the Fauna Nearctica, and it is more likely to prove to be this species.

It must be observed that this large species, whose description follows, differs absolutely only in the broader muzzle, and wider separation of the outer nares. The *A. tigrinum* retains in this case a feature characteristic of the larva of *A. mavortium* and of all other *Siredon* species. The range of color variation is only partly different in the two, but the majority of specimens of each belong to different color types. Each occupy a different geographical area, both of which are well marked in the distribution of many other reptiles. Nevertheless, ultimately I think it quite possible that they will have to be viewed as developmental forms like so many other supposed species, which are not sufficiently isolated from one another at the present time to warrant them distinct places and names in the system.

The *Siredon* of the Table Land of Mexico is different from those of the species described in this essay, as already pointed out.* As the metamorphosed stage, if existing, has not yet been obtained, I introduce it into this synopsis by name only.

| Cat. No. | No. of Spec. | Locality. | From whom received. |
|----------|--------------|---------------------|--|
| 3979 | | Detroit. | Dr. A. Sager (type of <i>A. luridum</i>). |
| 4691 | 40 (ad.) | W. Northfield, Ill. | R. Kennicott. |
| 4097 | 30 | N. Illinois. | |
| 4003 | 6 | Racine, Wis. | Dr. Hoy. |
| 3983 | 1 | Rock Island, Ill. | J. D. Sergeant. |

*Proc. A. N. Sci., Phil., 1866, 300.

| | | | |
|------|--------|--------------------------|----------------------|
| 3992 | 2 | S. Illinois. | R. Kennicott. |
| 3974 | 4 | Columbus, O. | L. Lesquereaux. |
| 3971 | 1 | Marietta, O. | Prof. Andrews. |
| 4706 | 2 | Grand Coteau, La. | St. Charles College. |
| 3966 | 2 | Mississippi. | Dr. Shumard. |
| 3956 | (30) 1 | New York. | J. C. Brevoort. |
| 3895 | 1 | St. Louis. | Dr. Engelman. |
| 3993 | 1 | Russellville, Ky. (1852) | Dr. Geo. R. Bibb. |
| 4040 | 2 | Lake Encenito, Ill. | J. Potts. |
| 3899 | 2 | Detroit, Mich. | Dr. A. Sager. |
| 3887 | 1 | Ann Arbor, Mich. | S. F. Baird. |
| 4707 | 1 | Racine, | S. F. Baird. |
| 4059 | 1 | Fort Ripley, Minn. | Dr. J. F. Head. |
| 4692 | 3 | Beesley's Pt., N. J. | S. F. Baird. |

AMBLYSTOMA MEXICANUM Cope.

Gyrinus m. (1800?) Shaw and Nodder, Nat. Misc., pl. 342, 343. *Siren pisciformis* (1802?) Shaw, Gen. Zool. Amph., p. 612. *Siredon axolotl* (1833) Wagler, Jones' Amph., pl. 20; Axolotl (1811) Cuv., Rept. dout. in Humb., Obs. Zool. 104, pl. 14. *Hypoethon pisciformis* (1829) Gravenhorst, Del. Mus. Vratislav., p. 89. *Acholotes guttatus*, (July, 1844,) R. Owen. Ann. and Mag. Nat. Hist. xiv., p. 23.

? Lakes, City of Mexico. Dr. C. Sartorius.

4. Table Land, Mexico.

AMBLYSTOMA MAVORTIUM Baird.

Journ. Ac. Nat. Sci. Phila. 1847, 292. Hallowell, l. c. iii. *A. proserpine* Baird. Hallowell, l. c. 354. *A. maculatum* Hallowell, l. c. 355, Proceed. 1857, 215. *Camarataxis maculata* Cope, Pr. Ac. Nat. Sci. Phila. 1859, 122. *A. nebulosum* Hallowell, Sitgreave's Rep. Zuni and Colorado, J. A. N. Sci. iii. 352. *A. californiense* Gray, Proc. Zool. Soc. London, 1853, 11, Tab. *Desmiostoma maculatum* Sager, Peninsular Journ. Medicine, 1858, 428.

Palatine teeth in a transverse series, more or less angular anteriorly; reaching to the posterior border of the inner nares, or one diameter beyond. The angle sometimes flattened or rounded. The series scarcely or not at all interrupted on the median line; never (?) on the limbs, which are generally a little undulatory.

Inner nostrils separated by the same space as the outer.

Tongue broader than long; more than half the width of the head; thick and fleshy.

Body very heavy, with 12 costal furrows. Head very broad, contained about $3\frac{1}{2}$ times in distance from snout to groin. Tail about equal to the same distance, much compressed from the base. Males in breeding season with a distinct fin from near the base of the tail above, and from beyond the middle below; tail more oval at other seasons. Cloacal region of male much swollen, emarginate—angular behind.

Legs moderate; digits much depressed, very broad at base; triangular, and adapted for swimming. Free portion of digits about one-third the distance from their tips to elbow or knee.

General color dark brown or blackish; in alcohol varied with blotches of yellow. These are disposed along the median line of the back and tail (extending down on the sides) as transverse ellipsoid bands of large size, perhaps equal to the space between the costal grooves. The blotches of opposite sides sometimes alternate, sometimes are opposite, and are frequently confluent here and there, which is generally the case on the tail, where they form yellow, encircling rings interrupted below. Along the sides of belly and lower part of the sides is a similar series of yellow ellipses, but usually larger; those of the same side usually somewhat confluent, sometimes entirely so, leaving a dusky central line of the belly. The limbs are blotched black or yellow.

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The yellow sometimes predominates so as to almost form the ground color, encroaching largely, too, on the yellow of the belly. In general, however, there is little or no tendency to anastomosis or reticulation of the dark interspaces as in an allied species. Smaller rounded irregularly scattered spots of yellow are seldom if ever seen as in *A. var. luridum*.

The ground color is sometimes uniformly dusky above, although the lighter transverse ellipsis can usually be made out; perhaps they are always appreciable in life.

In the preceding general description I have endeavored to represent the distinguishing features of what I believe to be a single species, varying very much in shape of palatine teeth, proportions, color, etc. From the synonymy it will be seen that I combine under the oldest name of *mavortium*, *proserpine*, and *nebulosum*. Although the type specimens of these supposed species differ sufficiently among each other, yet there are sufficient connecting links in the large series before me, and it would be no difficult task to pick out a dozen more specimens each as distinct from each other and the above as the latter are among themselves.

One great source of the diversity of character in different specimens of this protean species is to be found in the very different size of specimens in the same stage of growth, while in some the full metamorphosis will have been accomplished with a length of three or four inches; in others the branchiæ are still visible at a much greater size. In one female specimen of 8 inches in length (4978) the branchiæ are still appreciable, the fissures in the neck not being closed up, although the ovaries and oviduct would indicate that it was captured when in full breeding condition. This embryonic tendency is almost always indicated further by shorter gape of the mouth; the tongue smaller, flatter, more adherent, not at all or very little free at the edges, and little or not at all papillose, but exhibiting a cartilaginous surface. The palatine teeth in the embryonic state are alone usually more arched anteriorly; more or less parallel with the maxillary series; less prominent above the soft palate, and extending to a less distance laterally. The digits are more depressed, their outlines more oval than triangular, the 3d and 4th toes and 2d and 3d fingers more nearly equal.

The development of the different embryonic conditions may be carried on very unequally in different specimens, so that it is very unsafe to base specific characters upon small individuals, or even upon large ones in which there is the slightest indication of the branchial slits or their tufts.

The same adult individual differs, too, in different seasons. While some species appear to reside almost entirely in water, others do so only partially. Even the same specimen may pass a more aquatic life in one year than in another. A more persistent residence in water is shown by the broader and more depressed digits, higher and more compressed tail, and more or less decided ridge (sometimes even membranous). I have no doubt that an animal, while possessing these features in marked degree when in the water, would lose them to a measurable extent after a lengthened residence on land. This aquatic habit is generally greatest during the breeding season.

The preceding diagnosis and remarks are taken entire from Prof. Baird's manuscript. I will further extend and illustrate the same, and add that the names *A. californiense* and *A. maculatum* have been applied by Gray and Hallowell, and *Desmiostoma maculatum*, by Sager, to forms of this species.

Various changes of form during the late metamorphosis of this animal have been already enumerated in the prefatory remarks on the genus. A feature of difference mentioned above, the varying length of the fourth digit, appears to be quite independent of other developmental conditions. In a specimen in the Mus. Academy, from Kansas, this digit has but three phalanges on both feet; in another from the same locality 3 on one, 4 on the other foot, and the same occurs in No. 3994 Mus. Smithsonian. In *all* the other specimens at my disposal they are, as in this section of the genus, 4—4.

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The varieties of this species, which may be distinguished by their coloration are as follows:

a. (*californiense*.) Blackish, with slightly paler belly; a series of large oval yellow spots on lower part of side and tail (in one specimen a few on each side of dorsal line). System of mucous pores well developed, especially below ramus of the jaw on each side. From California only; eight specimens; No. 4081.

β. Brown, yellowish below; larger lateral and smaller dorsal yellow spots, irregularly arranged. Fewer mucous pores on each side the gular region. Fourteen specimens; mostly from Kansas and Nebraska, one from Missouri, one from lat. 38°, two from New Mexico, and two from Chihuahua. Nos. 4065, 4040, 3955a, 4062, 4084, 4908, 3984a. The type of *A. nebulosum* belongs here. There is no material difference between this and the coloration of *A. tigrinum*.

γ. Ground brown, crossed by transverse yellow bands, which inosculate more or less on the dorsal region, so as to obscure, sometimes almost entirely, the ground; mucous pores as in the last; belly with a median dark or black band. Sometimes the yellow is shaded with olive. Nos. 4613, 4705, 3990, 4703, 4694 to '99, 3955, 4078, 4079, 4066, 3982, 5359, 4082, 3994. No. 4020 might be assigned to either *β* or *γ*.

δ. Ground olive, with numerous small brown spots; otherwise as above. No. 4693 and the type of *A. maculatum* in Mus. Academy.

ε. Brown above, yellowish below; otherwise as above; 3984b, 4702, 3992, 3955b; from most diverse localities.

ξ. Color as in *γ*, the yellow leaving only inosculating lines of brown; no frontal, nasal or mandibular series of mucous pores; 4698 one specimen

So much to the principal of ornamental variation; the following are the forms resulting from unequal development of parts; the reader will observe by the numbers how partially they coincide with each other and with the preceding.

Type A. Palatine teeth in a gentle arch convex forwards, not extending between nares; the teeth (but not the ridge) interrupted inside the series behind the nares. Nos. 4908 and 5359 (2 sp.); in all respects fully grown, the former not more than half the size of the usual type. Approach distantly *A. trisruptum* Cope.

Type B. Palatine teeth forming a straight series on each side, meeting at a more or less open angle between the nares. Most of the specimens: Nos. 4702, 3992, 4705, 4613, 4065, 4040, 4698, 3990, 4703, 4694 to '99, 4081, 3955, 4079. Of these the angle of the tooth series does not extend beyond the anterior margin of the nares in twenty-six specimens, of which one exhibits a small, undeveloped tongue, and none have the stumps of the branchiæ remaining. In eleven specimens the angle extends beyond this point (in 3990 and another approaching an arch in form); and of these the tongue is small and larval in six, and in one of these stumps of the branchiæ remain; this last is of medium size only, but Nos. 4693 and 3694 are large, the first very large; they add the larval character of a short, deep tail. It is to be noted that these specimens are from Minnesota and the borders of British America, regions subject to great cold, to which cause we may, with much probability, assign their characters. Two individuals presenting the same peculiarities are described under the head of *A. tigrinum*. Of two specimens from Chihuahua, fully developed, the teeth are of the two types: of eight from California one presents the second type only; it is otherwise fully developed.

Type C. The postnarial portion of the palatine series has nearly or quite assumed its transverse position, while the median series remains in its larval arch, extending more or less in advance of the nares. Eight specimens, four of the largest size: 3955a, 4078, 4062, 4084; two Mus. Academy, one type of *A. maculatum* Hall. Of these two have the small tongue and traces of branchiæ, while four are fully developed in these respects.

Type D. Palatine series forming a parabolic arch from one extremity to the

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other, extending in advance of the nares. Three specimens, two of them of full but not large size; one of the former full double the size of others from the same locality (the Platte Valley), which are referred to Types C and B, has larval tongue and branchial stumps. The others, 4066, with larval tongue, but the branchiæ absorbed.

Here may be mentioned a remarkable specimen, 3982, which is in all other respects fully developed, where the larval arch of teeth remains, but has become open and slightly transverse, extending but little beyond the anterior margin of the nares. It is intermediate between Types D and A, and is the result of a retardation in development of the larval arch, while Type B is produced by a retardation or preservation of the oblique lateral series of the larva, at the expense of the arch.

I add here a description of the var. *californiense*, for the sake of determination of varieties and species that may be found hereafter.

The proportions of this variety and general character of the glands, pits, etc., appear much like those of *A. var. luridum*, in some respects of *A. punctatum*. I do not detect any patches of large pores on the top of the head and neck in one specimen, but in another a series of large whitish dots beneath the epidermis seems to indicate their presence. Of these one patch is placed on top of head within the orbit; another on the parotid region. Some pores, however, are distinctly visible behind the angle of the mouth, sending forward a series along the margin of the lower jaw, under the chin.

The head is broad but also long, the width being decidedly less than the distance from snout to gular fold. The gape is very large, the length nearly two-thirds the width. The width in seven specimens is contained $4\frac{1}{2}$ times in the distance from snout to groin; in one specimen four times only. The eyes are separated only by $2\frac{1}{2}$ lengths of the orbit.

The tongue is very large, nearly filling the whole lower jaw. It is three-fourths the width of the head.

There is quite a difference in the character of the palatine teeth of the ten specimens before me. In both the central part of the series forms a decided V; the angle sharp, and reaching to the line of the anterior margin of the inner nostrils. The limbs extend backwards slightly in an S shape to a short distance behind the inner nostrils and in line with their inner border, and then connect with the external segment of the palatine series, which extend (nearly transversely but a little oblique backwards) to a line with the outer margin of the inner nostrils. In both specimens the two sides of the palatine series are not symmetrical and of unequal length, one specimen showing a distinct interval between the central V and the lateral segment, as well as at the angle of the V; in the other these four elements are continuous.

There appear to be 12 costal furrows. The tail is compressed but not high; in one specimen it is as long as head and body; in another shorter; shows a sharp ridge above from near the base and from the terminal half below in one specimen; not so much in another. The limbs are well developed; the digits depressed and triangular, but less so than in many aquatic *Amblystomata*, as *A. luridum*.

The color of the species is blackish in alcohol, rather paler below. On each side of the belly or lower part of the sides of body and tail is a series of bright sulphur yellow spots, mostly nearly circular, sometimes oblong, and varying in size, though generally larger than the orbit. The spots are few in number—five or six from head to tail, and four or five on the side of tail.

In one of the specimens are some smaller rounded spots on each side of the dorsal line; three or four in each series; these are not symmetrically disposed, as in *A. punctatum*.

As Dr. Gray remarks, this species has a certain resemblance externally to *A. punctatum*, which, however, never exhibits the series of spots on the side

| | |
|---|-------|
| Free portion of longest finger contained in distance from elbow to tip, not quite 3 | |
| “ “ toe “ “ knee to tip..... | 3 |
| Length tail from behind anus, to rest of animal..... | less. |

Measurements.

| | |
|---|------|
| Length (measured along axis of body) from snout to gape... .. | ·40 |
| “ “ “ “ gular fold..... | ·85 |
| “ “ “ “ armpit..... | 1·25 |
| “ “ “ “ groin..... | 3·00 |
| “ “ “ “ behind anus..... | 3·75 |
| “ “ “ “ end of tail..... | 6·20 |
| Width of head..... | ·70 |
| “ tongue..... | ·45 |
| Length of orbit..... | ·18 |
| Distance between eyes anteriorly..... | ·40 |
| “ “ outer nostrils | ·30 |
| “ “ inner nostrils..... | ·30 |
| “ “ armpit and groin..... | 1·75 |
| Height of tail where highest..... | ·30 |
| Breadth “ “ | ·18 |
| Free portion of longest finger..... | ·28 |
| From elbow to tip of longest finger..... | ·80 |
| Free portion of longest toe..... | ·30 |
| From knee to tip of longest toe..... | ·90 |
| Distance between outstretched toes..... | 2 85 |

*Proportional dimensions.*Specimen 3955 (1). Var. *mavortium*. Fort Bliss.

| | |
|--|--------------------------------|
| Length of gape of mouth, to its width..... | $\frac{1}{2}$ |
| Width, to distance from snout to gular fold... .. | equal. |
| “ “ “ groin..... | cont. $3\frac{1}{2}$ times. |
| “ “ “ behind anus | $4\frac{1}{2}$ “ |
| From snout to gular fold, contained in distance from snout to groin..... | $3\frac{1}{2}$ |
| From snout to gular fold, contained in distance from snout to behind anus..... | $4\frac{1}{2}$ |
| Distance anteriorly between eyes, in length of orbit..... | 3 |
| “ from eyes to nostrils “ “ | 1+ |
| “ between external nostrils “ “ | nearly 2 |
| “ “ internal “ “ | $2\frac{1}{4}$ |
| Width of tongue, to width of head..... | rather more than $\frac{1}{2}$ |
| Free portion of longest finger contained in distance from elbow to tip..... | 3 |
| Free portion of longest toe contained in distance from knee to tip..... | nearly 4 |
| Distance between outstretched toes in length from snout to groin..... | once. |
| Length tail from behind anus, to rest of animal..... | nearly equal. |

Measurements.

| | |
|---|------|
| Length (measured along axis of body) from snout to gape.... | ·60 |
| “ “ “ “ gular fold | 1·00 |
| “ “ “ “ groin | 3 50 |
| “ “ “ “ behind anus..... | 4·50 |
| “ “ “ “ end of tail..... | 4·00 |
| Width of head..... | 1·05 |
| “ tongue..... | ·55 |
| Length of tongue..... | ·45 |
| “ orbit | ·22 |

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| | |
|--|------|
| Distance between eyes anteriorly..... | ·65 |
| " " outer nostrils..... | ·40 |
| " " inner " | ·45 |
| Height of tail where highest..... | ·75 |
| Breadth " " | ·45 |
| Free portion of longest finger..... | ·30 |
| From elbow to tip of longest finger..... | ·95 |
| Free portion of longest toe..... | ·32 |
| From knee to tip of longest toe..... | 1·15 |
| Distance between outstretched toes..... | 3·50 |

*Proportional dimensions of*Spec. 4082, type of var *proserpine*. Tamaulipas.

| | |
|--|------------------|
| Length of gape of mouth, to its width..... | more than half. |
| Width, to distance from snout to gular fold..... | not quite equal. |
| " " " groin..... | nearly 4. |
| " " " behind anus..... | 4½+ |
| From snout to gular fold, contained in distance from snout to groin..... | 3½ |
| From snout to gular fold, contained in distance from snout to behind anus..... | 4 |
| Distance anteriorly between eyes, in length of orbit..... | 3· |
| " from eyes to nostrils " " | 1 |
| " between external nostrils, " " | 2 nearly. |
| " " internal " " " | 2 " |
| Width of tongue, to width of head..... | more than half. |
| Free portion of longest finger contained in distance from elbow to tip..... | 3 times. |
| Free portion of longest toe contained in distance from knee to tip..... | 3 times. |
| Length tail from behind anus, to rest of animal..... | less. |

Measurements.

| | |
|--|------|
| Length (measured along axis of body) from snout to gape..... | ·34 |
| " " " gular fold..... | ·60 |
| " " " armpit..... | ·90 |
| " " " groin..... | 2·00 |
| " " " behind anus..... | 2·40 |
| " " " end of tail..... | 4·10 |
| Width of head..... | ·52 |
| Distance between eyes anteriorly..... | ·32 |
| " " outer nostrils..... | ·23 |
| " " inner nostrils..... | ·24 |
| Height of tail where highest..... | ·25 |
| Breadth " " | ·12 |
| Free portion of longest finger..... | ·20 |
| From elbow to tip of longest finger..... | ·60 |
| Free portion of longest toe..... | ·19 |
| From knee to tip of longest toe..... | ·61 |
| Distance between outstretched toes..... | 1·75 |

Proportional dimensions of

Spec. 4696. Cimarron R.

| | |
|--|-----------------|
| Length of gape of mouth, to its width..... | about one-half. |
| Width, to distance from snout to gular fold..... | equal. |
| " " " groin..... | 4 |
| From snout to gular fold, contained in distance from snout to groin..... | 4 |

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| | |
|--|----------------|
| From snout to gular fold, contained in distance from snout to behind anus..... | nearly 5. |
| Distance anteriorly between eyes, in length of orbit..... | 3 |
| “ from eyes to nostrils “ “ | 1½ |
| “ between external nostrils, “ “ | nearly 2. |
| “ “ internal “ “ | 2 |
| Width of tongue, to width of head..... | little over ½. |
| Free portion of longest finger contained in distance from elbow to tip..... | 3¼ |
| Free portion of longest toe contained in distance from knee to tip | 3½ |
| Distance between outstretched toes in length from snout to groin | about equal. |
| Width of body compared with that of head..... | equal. |

Measurements.

| | |
|--|------|
| Length (measured along axis of body) from snout to gape..... | .55 |
| “ “ “ gular fold..... | 1.00 |
| “ “ “ armpit..... | 1.55 |
| “ “ “ groin..... | 3.90 |
| “ “ “ behind anus | 4.75 |
| “ “ “ end of tail..... | 8.75 |
| Width of head..... | 1.00 |
| Length of orbit | .20 |
| Distance between eyes anteriorly..... | .56 |
| “ “ outer nostrils..... | .35 |
| “ “ inner “ | .36 |
| Circumference of belly..... | 3.75 |
| Distance between armpit and groin..... | 2.25 |
| Height of tail where highest..... | .70 |
| Breadth “ “ | .40 |
| Free portion of longest finger..... | .27 |
| From elbow to tip of longest finger..... | .95 |
| Free portion of longest toe..... | .32 |
| From knee to tip of longest toe. | 1.25 |
| Distance between outstretched toes..... | 3.55 |

| Cat. No. | No. of spec. | Locality. | From whom received. |
|------------|--------------|--------------------------------|---|
| 3990 | 1 | New Mexico. | Dr. J. Le Conte, type of spec. |
| 4084 | 1 | “ “ | “ “ |
| 4702 | 1 | San Francisco Mts., Nev. | { Capt. Sitgreaves, type of <i>A. nebulosum</i> . |
| 3955 | 5 | Fort Bliss, N. M. | Dr. S. W. Crawford. |
| 4065 | 1 | Mimbres R. | Dr. Webb. |
| 4078 (35) | 1 | Fort Thorn. | Dr. Henry. |
| 4705 | 1♂ | Fort Union, Neb. | Dr. Hayden. |
| 4066 | 1 | Rock Creek, K. T. | Lt. Bryan, W. S. Wood. |
| 4079 | 1 | Fort Benton. | Dr. Hayden. |
| 4062 | 1 | Rocky Mts. | Capt. Beckwith. |
| 4698 | 1 | Bridgers Pass. | Lt. Bryan, W. S. Wood. |
| 4011 | 1 | Sand Hills of Platte. | Dr. Hayden. |
| 3982 | 1 | Ft. Pierre. | Th. A. Culbertson. |
| 4020 (84) | 2 | Fort Laramie. | Dr. Hayden (<i>proserpine</i> ?). |
| 4695 | | Fort Riley. | Dr. W. A. Hammond. |
| 4694 (2) | ♀ | Mo. of Cimarron. | J. H. Clark. |
| 4697 (365) | ♀ | Lower Platte. | Dr. J. H. Cooper. |
| 4696 | ♂ | N. Fork of Canadian. | J. H. Clark. |
| 4699 | | Cimarron R., near Salt Plains. | “ |
| 4082 (91) | 3 | Tamaulipas. | Dr. Edwards, type <i>proserpine</i> . |

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| | | | |
|------|---|------------------------|------------------------------|
| 4057 | 1 | New Mexico. | Ed. Kern. |
| 3984 | | Lac qui Parle, Minn. | S. R. Riggs. |
| 4693 | | N. Red River, H. B. T. | C. Cavileer. |
| 4081 | 2 | Petaluma, Cal. | E. Samuels, soft spec. desc. |

Numerous specimens from near San Francisco in Mus. Compar. Zoology.

AMBLYSTOMA OBSCURUM Baird.

M. S. Species nova.

In the greatly corrugated condition of the present specimen, it is impossible to make out any satisfactory description of the integuments. They, however, appear much as in the other stout aquatic species. The head is very broad, and the gape unusually large. The internal nostrils are very large; their width half the diameter of the eye; the distance between their inner borders is the same as that between the outer. The tongue is large, broader than long; its width about two-thirds that of the upper jaw.

The palatine teeth are in four series collectively, forming a broad inverted V; the angle is anterior, and would be quite sharp but that there is an interruption along the median line. The branches reach as far forward as the anterior border of the inner nostrils. They are decidedly concave antero-externally. The two inner anterior sections of the palatine series are each about twice the length of the external ones; they fall short of the inner border of the inner nares by nearly a diameter of the latter, which space separates them from the outer section, which, immediately behind the inner nares, are about as long as the latter are wide, and do not pass exterior to their outer border.

As nearly as can be ascertained, there are twelve costal furrows. The tail is compressed, but not high.

The color appears to have been of a uniform brown above and on the sides; brownish-yellow beneath; on the sides, darker vertical blotches can be detected in the single specimen before me; similarly indistinct markings are visible on the tail.

The very convex frontal region, and the concave interrupted series of teeth alone distinguish this species from the *A. mavortium* of the brown variety. It differs from *A. tigrinum* in much larger inner nares, and more widely separated nostrils; the inner borders of the two being at about the same distance, instead of having the latter more approximated. The tongue is wider, as well as the head. The teeth are more V-shaped, reach farther forward; the outline of the limbs of the V is concave antero-externally, and interrupted by spaces equal to the wide nostrils; the outer sections not extending beyond the nostrils.

Measurements.

| | In. | Lin. |
|---|-----|-------|
| Length (along axis) from snout to gape..... | | 7.8 |
| “ “ “ gular fold..... | | 12.75 |
| “ “ “ axilla..... | 1 | 8.75 |
| “ “ “ groin..... | 4 | 1.15 |
| “ “ “ behind vent..... | 5 | 0.15 |
| “ “ of tail..... | 3 | 2. |
| “ from elbow to tip of longest finger..... | | 12.75 |
| “ “ knee “ “ toe..... | 1 | 4.5 |
| Width of head at angle jaw..... | | 10.9 |
| “ between eyes anteriorly..... | | 6.1 |
| “ “ external nares..... | | 4.5 |

| No. | No. of spec. | Locality. | From Whom. |
|------|--------------|------------------------|--------------|
| 3994 | 1 | Fort Des Moines, Iowa. | W. E. Moore. |

AMBLYSTOMA XIPHIAS Cope.

Spec. nov.

The specimen selected as the type of the description has the skin somewhat

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altered by alcohol, so that an exact description cannot be made of the glands, pits and pores. There does not, however, appear to be any material difference from *A. tigrinum* in these respects.

The head appears small in proportion to the size of the animal, and the cheeks unusually swollen; the width of the head is contained five times in the distance to groin. The mandible projects beyond the end of the muzzle. The eyes are rather small, distant three lengths of the orbit. The inner nostrils are considerably more distant than the outer. The tongue is large and fleshy, filling the rami anteriorly, and more than half the width of the head. The inner nostrils are quite lateral.

The palatine teeth form a very obtuse angle anteriorly, reaching to about opposite the middle of the inner nares, and extending laterally beyond them by about one diameter. There is a slight interruption along the median line, but no appreciable one elsewhere. The limbs of the V are not straight, but form a double curve (scarcely appreciable) on each side.

There are twelve costal grooves; others are not appreciable, except those at the base of the tail.

The tail is very long, considerably exceeding the rest of the animal; much compressed from the base, though not elevated. Oval in cross section, and only becoming sharp near the tip, without any crest. No grooves are visible along dorsal or ventral outline.

There do not appear to be any peculiarities in the feet distinguishing it from other aquatic *Amblystomas*.

The color of this species is a yellowish-olive; brighter yellow beneath, with more or less anastomosing or reticulating bands of well-defined brown on the back and sides, and a few rounded spots of the same on the belly. These bands in width average perhaps the diameter of the eye, though variable in this respect.

Compared with *A. tigrinum* this species has a proportionally smaller head, much longer tail, and different color; yellow predominating in the one, and brown in the other. The relationship, however, appears to be very close. The digits perhaps are narrower, though also triangular and depressed.

A large *Amblystoma mavortium*, No. 4705, from Fort Union, at the mouth of the Yellowstone, with the same coloration as the preceding, differs in rather shorter tail, the ridge of which is more acute; broader toes; and a considerably broader and otherwise different head, the width of which is contained about four times in distance from snout to groin, not five times. The palatine teeth do not extend laterally beyond the centres of the inner nostrils, which are separated more widely than are the outer. The tongue is larger and more fleshy. The dusky marks on the tail are not reticulated, but transverse, and the under side is dusky, not yellow. This very great and marked difference in the form and size of the head of the two specimens, although that with the smaller head is considerably the larger of the two, indicates the distinctness of the species.

Measurements.

| | In. | Lin. |
|---|-----|-------|
| Length (along axis) from snout to gape..... | | 7.25 |
| “ “ “ gular fold..... | 1 | 0. |
| “ “ “ axilla..... | 1 | 11.25 |
| “ “ “ groin..... | 4 | 2.5 |
| “ “ “ behind vent..... | 5 | 3. |
| “ of tail..... | 6 | |
| “ from knee to tip of longest toe..... | 1 | 3.1 |
| Width of head at angle jaw..... | | 10.5 |
| “ between eyes anteriorly..... | | 6.5 |
| “ external nares..... | | 3.7 |

| Mus. No. | No. of Spec. | Locality. | Donor. |
|----------|--------------|-----------------|------------------|
| 4135 | 1 | Columbus, Ohio. | Leo Lesquereaux. |

AMBLYSTOMA TRISRUPTUM Cope.

Spec. nov.

The species is stout and heavy in build; the head very broad, and much depressed. The skin is granulated by contraction of the alcohol, but in respect to glands, pits, etc., appears much like other species. There is, however, a decided feature in certain particles which crowd the parotid region, and are seen also on the top of the head along the inner margin of the orbit, and perhaps below the eye. I have not noticed this character in any other species east of the Rocky Mountains.

The head is broad, ovate, rather pointed anteriorly. The inner and outer nostrils nearly the same distance apart. The tongue is broader than long, more than half the width of the head, filling the interspace of the rami anteriorly.

The teeth are in four very distinct patches, with decided intervals. They form one transverse series, nearly straight centrally (where they are in a line with the posterior border of the internal nares), but curving slightly backwards laterally. The two central patches are wider than the lateral, which vary a little in length, and are separated by an interval half the diameter of the inner nares; their distance from the exterior patches is about twice as great, the centre of the interval falling about opposite to the inner border of inner nares. The outer patches extend about half a diameter beyond the outer border of inner nares.

The remaining external characters of the specimen are not different from those of *A. tigrinum*.

The colors of the specimen are much obscured by preservation. It appears to have been of a uniform dark blackish or bluish-brown, with a single series of large transversely elliptical blotches of yellow from head to tip of tail, half in body and half in tail, the foremost one rounded, and placed behind the eyes. Those of opposite sides nearly meet on the back, and are confluent on the upper edge of the tail.

This is the only species I have seen of the group in which a strictly transverse series of palatine teeth behind the eye is divided into four groups.

Proportional dimensions.

Spec. 4068. Ocate River, N. M. ♀.

| | |
|--|------------------------|
| Length of gape of mouth, to its width..... | little more than half. |
| Width, to distance from snout to gular fold..... | not quite equal. |
| “ “ “ groin..... | 4 times. |
| From snout to gular fold, contained in distance from snout to groin..... | 3½ |
| Distance anteriorly between eyes, in length of orbit.... | 3 |
| “ from eyes to nostrils “ “ | 1¼ |
| “ between external nostrils, “ “ | not quite 2 |
| “ “ internal “ “ “ | 2 |
| Width of tongue, to width of head..... | over ½ |
| Free portion of longest finger contained in distance from elbow to tip..... | little over 3 times. |
| Free portion of longest toe contained in distance from knee to tip..... | 3½ |
| Distance between outstretched toes in length from snout to groin..... | about equal. |
| Length tail from behind anus, to rest of animal | less. |

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Measurements.

| | |
|---|------|
| Length (measured along axis of body) from snout to gape | ·45 |
| “ “ “ gular fold | ·90 |
| “ “ “ armpit..... | 1·45 |
| “ “ “ groin | 3·15 |
| “ “ “ behind anus..... | 3·80 |
| “ “ “ end of tail..... | 6·80 |
| Width of head..... | ·80 |
| “ tongue..... | ·45 |
| “ orbit | ·18 |
| Distance between eyes anteriorly..... | ·50 |
| “ “ outer nostrils | ·22 |
| “ “ inner “ | ·30 |
| “ “ armpit and groin..... | 1·80 |
| Height of tail where highest..... | ·46 |
| Breadth “ “ | ·24 |
| Free portion of longest finger..... | ·26 |
| From elbow to tip of longest finger..... | ·90 |
| Free portion of longest toe..... | ·29 |
| From knee to tip of longest toe..... | ·96 |
| Distance between outstretched toes..... | 3·00 |

One spec. 4068. ♀ Ocate River, N. M., from John Potts.

AMBLYSTOMA JEFFERSONIANUM Baird.

Jour. Acad. Nat. Sci. i. 283. *Salamandra* Green, Contr. Maclurean Lyceum i. p. 4, 1827; Holbr., N. Amer. Herp. v. 51, pl. 14. *Triton niger* Dekay, Geol. Surv. N. Y. Zool. iii. 85, pl. 15, f. 35. *Salamandra granulata* Dekay, l. c. 1842, 78, pl. 23, f. 66. *Xiphonura jeffersoniana* Tschudi, 1838, Class. Batr. Gray, Catal. Brit. Mus., 1850, 34. *Amblystoma fuscum* Hallow., Journ. A. N. Sci. iii. 355. *Amb. laterale* Hallow., l. c. 352.

Body decidedly more slender and elongate than in *A. punctatum*. Skin everywhere smooth, and showing through the transparent epidermis the ends of the glands, which thickly stud the entire surface. Under a lens are seen numerous small rounded, shallow pits between the glands, not on them. The contraction of the skin, in strong alcohol, between these glands, would readily impart a granulated appearance. The glandules are accumulated into a thin stratum above the parotid groove.

The head is elongated, with the muzzle obtuse or truncate, the greatest width contained one time in the distance to gular fold, and from four and a half to five times to the groin; the distance to the gular fold is contained three and two-thirds times in that to the groin. The eyes are rather large, and situated far behind. They are distant once the length of the orbit from the nostrils (which are separated by nearly twice this length). The anterior extremities of the orbit are distant more than twice this length.

The gular fold or furrow is distinct, not very prominent above; that behind the angle of the jaws is inconspicuous, as is the lateral parotid furrow.

There are twelve costal furrows, including the inguinal and axillary.

The tail is a little shorter than the body and head (measuring from posterior extremity of vent.) It is oval in cross section, largest below, though without any ridge or crest. It is little higher than broad at the anus, but becomes more and more compressed to the tip, the upper and under outlines remaining nearly parallel for a considerable distance. The anal slit is prolonged into a groove, which extends beneath the tail to its very tip.

The tail is curved strongly upwards in the alcoholic specimen, but this is due to the corrugation of the spirit.

The limbs are largely developed, and the toes very long. The digits cylindrical, depressed, without any lateral or basal web. The third finger is long-

est, then the second, fourth and first. It is one-third the length of arm from elbow. The fourth toe is longest, then the third (but little shorter), second, fifth and first; it is contained about two and a half or two times in the length of leg from knee. The expanse of the outstretched toes is very nearly equal to the distance from snout to the groin. The length of the limbs varies a little; when extended on the sides they may scarcely meet, or considerably overlap.

The tongue is thick and fleshy; much as in *A. punctatum*.

The teeth are in four patches; the two central in nearly a straight line, or forming in smaller individuals a very obtuse Δ , the angle anterior, but not passing the posterior border of the internal nares; the sides of the Δ are perhaps slightly concave anteriorly. This patch or line extends to the inner nares, and is there continuous with the lateral patches, which are short, nearly straight, about one-fourth the central patch, and form the posterior border of the inner nares. These are large, far back, and widely separated.

In alcohol, after long immersion, the specimen is nearly uniform light liver-brown, paler beneath, without any spots.

| | |
|---|------|
| Length from snout to gular fold..... | ·70 |
| “ “ groin | 2·55 |
| “ “ end of anus..... | 3·20 |
| “ remnant of tail..... | 2·50 |
| Width of head..... | ·50 |
| Length of mouth, along median line..... | ·38 |
| “ forearm from elbow..... | ·62 |
| “ leg from knee..... | ·85 |

The specimen from which the preceding description has been taken, is, if not the original upon which Dr. Green's species was founded, at least one collected in the same locality and named by him, having formed part of his collection, and presented many years ago by its owner to the Smithsonian Institution. The "light blue spots" so conspicuous in fresh specimens have disappeared.

Dr. Holbrook, in describing this species has mixed with it the account of the tongue and teeth of *Plethodon glutinosus*, which it somewhat resembles, but which may be readily distinguished externally by the lighter silvery spots, and much shorter digits. This induced Dr. Hallowell erroneously to make the species a synonym of *P. glutinosus*. The error had its origin, no doubt, in the nearer resemblance of the var. *laterale* to the latter species.

A confusion of the specimen described with the type of DeKay's *Salamandra granulata*, exhibits no appreciable difference except in the darker color, rather more depressed toes, and perhaps more massive looking jaws of the latter, the muzzle a little more pointed; all uncertain characters in alcoholic specimens. The palatine teeth are in better preservation than in the specimen here described. The central patch is interrupted along the middle line and does not extend quite so far laterally. The legs and digits are much lengthened, the figure and description of Holbrook (see DeKay) conveying a very erroneous impression in this respect. The granulation referred to is in part the optical effect of the glands of the skin, showing through the transparent epidermis; partly the result of contraction of the skin by alcohol.

In the type specimen there are no symmetrically arranged patches of pores on the head. Their absence may be owing to the long continued preservation of the specimens or to some accidental deficiency. In the type of *granulata* these are quite visible. They are very distinctly shown in No. 4688, where there is seen a straight series interior to the eye and nostril (not reaching to the latter), bending abruptly behind the eye and passing beneath it. On the parotid region above the lateral groove is a slightly curved line

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of six or eight pores, and a shorter straight one above it. Below the groove is a crowded patch which is continued into a simple series along the inner edge of the lower jaw. One or two are seen at the side of the base of the lower jaw, and others along the sides of body.

It has been stated that in the type no indication of light spots was visible. In others, however, of more recent preservation, these are quite evident. In the smallest specimen of 3998 are visible numerous rounded irregularly disposed light spots on the lower part of the sides, with some scattered over on the belly averaging half the size of the eye, but with faintly defined margins. Some scattered ones are seen on the side of the tail; these may be plumbeous or bluish in life.

In the largest specimen of 3979, Ripley, Ohio, these bluish spots are quite evident on the side of body and tail.

Generally the ground color is, of the alcoholic specimen, olive brown, sometimes blackish, lighter beneath. The color of the living animal is similar to that above described from alcoholic specimens.

The youngest specimen examined is about two inches long and is not materially different from the adult, although the two inner palatine patches appear more arched.

There are two varieties of this species other than the typical, as follows:

Var. *fuscum* (*Amblystoma fuscum* Hallow.) is dark brown, with an especially dark shade or band along the sides. Type in Mus. Academy from near Hanover Co., W. Indiana. 3697 Mus. Smithsonian, Clarke Co., Va.

Measurements of 3697.

| | |
|--|------|
| Length from snout to end of mouth..... | 30 |
| “ “ gular fold..... | 55 |
| “ “ groin..... | 1.90 |
| “ “ end of anal slit..... | 2.25 |
| “ “ end of tail..... | 3.80 |
| Width of head..... | .40 |
| Fore arm from elbow..... | .50 |
| Leg from knee..... | .62 |
| Extent of hind leg..... | 1.80 |

Var. *laterale* (*Amblystoma laterale* Hallow). The length of the fissure of the eye enter the width between the anterior canthi of the same twice only. The color black with large white spots on the sides and tail, and smaller ones on the belly. Size about half the size of the adult of the typical variety, and the medium series of palatine teeth convex forward. The distribution of this form is northward. Specimens 7011 and 5941 from Milwaukee and high land between River St. Lawrence and Hudson's Bay. In Mus. Academy, from Michigan and from north side Lake Superior.

The dark color of the coagulated blood in the vena lateralis gives rise sometimes to the deceptive appearance of a color stripe.

| Cat. No. | No. of Spec. | Locality. | From whom received. |
|----------|------------------|---------------------|--|
| 3968 | 1 | Canonsburg, Pa. | Dr. F. Bache. |
| 3979 | 4 | Ripley, Ohio. | Dr. Hoy. |
| 3998 | 1 is } 7145 } | 12 Cleveland, Ohio. | Dr. Kirtland. |
| 3989 | 2 | New York, | N. Y. State Cab. (type of <i>S. granulata</i> , DeKay. |
| 3997 | 1 | Racine, Wis. | Dr. Hoy. |
| 4689 | 1 | Lake Superior. | Dr. Hoy. |
| 4690 | 2 | St. Catharine, C.W. | D. W. Beadle. |
| 3888 | 2(larva) | Burlington, Vt. | Z. Thompson. |

Also from Philadelphia.

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AMBLYSTOMA PLATINEUM, Cope sp. nov.

This is one of the more elongate species and in many respects allied to the *A. jeffersonianum*.

The head is oval and the muzzle rounded. The length of the fissure of the eye equals the distance of the nostril from the same, is but little less than the distance between the nares, and half or a little more of the distance between the anterior canthus of the same. Inner and outer nares the same distance apart. Greatest width of head 5.5 to 6 times in length from end muzzle to groin, five sevenths length from chin to gular fold. Canthus of mouth behind canthus of eye. A series of pores along the superciliary, which pass round the orbit behind and below; a scattered longitudinal series on the parotoid region, and a transverse aggregation of the same on each side below parotoid groove; a single series of the same for a short distance inside the ramus of the mandible. The parotoid region possesses a thin stratum of dermal cryptæ.

Costal folds 12; the anterior is a little distance behind the axilla. Toes subcylindric, similar to that of the *A. jeffersonianum*; in one specimen (type) they are separated by nearly an intercostal space when the limbs are pressed to the sides; in another they meet. Tail rounded above at base, finally much compressed, but not elevated, equal, in one specimen body and head to middle orbit, measured from posterior extremity vent. In the type, however, it is much shorter, extending from its basis only to the eighth costal fold (from groin), but I am not sure that this is normal.

Color leaden, in type paler below with numerous indistinct whitish blotches. Eye lids yellowish margined. Sp. 4688 has the abdomen darker and without spots.

| No. | Locality. | Donor. | No. Sp. |
|------|------------------|-----------------------|---------|
| 7145 | Cleveland, Ohio. | Prof. J. P. Kirtland. | 1 |
| 4688 | Unknown. | Prof. Agassiz. | 1 |

The narrower head and more elongate body will distinguish this species from the *A. jeffersonianum*. It is readily distinguishable among many individuals, nevertheless many of those of the var. *lateralis* approach it in the proportions of the parts of the head to each other. These points are the closer approximation of the eyes and of the nostrils. The shorter body is, however, always preserved. The size of the *lateralis* is considerably less. Those of the typical var. of the same species are invariably stouter, not only in body but head.

AMBLYSTOMA MACRODACTYLUM Baird.

Journ. Ac. N. Sci. Phila. i. p. 292.

This species is the slenderest of all our species of *Amblystoma*, in this respect as well as length of digits exceeding even the *A. jeffersonianum*.

The specimen before me is too small to furnish any reliable indication as to the character of the glands, and pores of the skin. These are probably much as in *A. jeffersonianum*. No pores are visible on the head arranged in regular patterns.

The head is rather large, depressed and elongated, with a moderate constriction at the neck. The eyes are prominent and distant less than two lengths of the orbit. The outer and inner nostrils are each about one orbit distant. The width of the head is about three-quarters the distance to gular fold.

The tongue is oval and longitudinal. The palatine teeth are in three or four patches, the central largest, occasionally separated by an interval less than half the diameter of the inner nostrils; together they form a line, slightly angular anteriorly, where they reach to about opposite the centre of the inner nostrils; laterally they pass a little the outer margin of the inner nostrils.

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The body is cylindrical-depressed, with twelve costal furrows. The tail is broken; but from what is left appears to be somewhat compressed, but much rounded.

The color in alcohol appears to be brown with a well defined broad dorsal stripe of grayish brown, which involving the whole upper surface of the head and neck contracts on the nape, swelling again on the back, with an average breadth of the outer orbital space; this stripe seems to extend to the end of the tail. On each side of this dorsal stripe is a suffusion of dark brown which gradually pales through the color of the sides into the belly; there are also a few spots of the same in the dorsal stripe. There are a few grayish white dots scattered along the sides, and perhaps on the limbs.

Two specimens (4054) from Puget Sound, agree in form with the preceding specimen; the two central patches of palatine teeth perhaps a little more angularly arranged. Instead of the grayish dorsal stripe, however, there is a brownish red one, and the sides are of a darker and more continuous brown. No. 4711 has a similar character of palatines but a coloration more like the type. The palatines in fact extends a little in front of the anterior border of the inner nostrils.

Proportional Dimensions of 4042.

| | |
|--|------------------------|
| Length of gape of mouth, to its width..... | two thirds. |
| Width, to distance from snout to gular fold | about $\frac{3}{4}$. |
| " " " groin | 5 times. |
| From snout to gular fold, contained in distance from snout to groin..... | $3\frac{1}{2}$. |
| Distance anteriorly between eyes, in length of orbit..... | less than 2. |
| " between external nostrils..... | one orbit, |
| " " internal..... | " " |
| Free portion of longest finger contained in distance from elbow to tip..... | about $2\frac{1}{2}$. |
| Free portion of longest toe contained in distance from knee to tip..... | $2\frac{1}{2}$. |
| Distance between outstretched toes in length from snout to groin..... | about equal. |
| Number of costal furrows (including axillary and inguinal).... | 12. |

Measurements.

| | |
|--|------------|
| Length (measured along axis of body) from snout to gape..... | 20 |
| “ “ “ gular fold..... | 44 |
| “ “ “ armpit..... | 65 |
| “ “ “ groin..... | 1.50 |
| “ “ “ behind anus.... | 1.82 |
| “ “ “ end of tail..... | broken |
| Width of head..... | 30 |
| “ tongue..... | 17 |
| Length of orbit..... | 12 |
| Distance between eyes anteriorly..... | 20 |
| “ “ outer nostrils..... | 12 |
| “ “ inner nostrils..... | 12 |
| “ “ armpit and groin..... | 90 |
| Height of tail where highest..... | 18 |
| Free portion of longest finger..... | 15 |
| From elbow to tip of longest finger..... | 39 |
| Free portion of longest toe..... | 20 |
| From knee to tip of longest toe..... | 50 |
| Distance between outstretched toes..... | 1.40 |
| Total length of a larger specimen..... | 4 in. 4 l. |

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| Cat. No. | No. of Spec. | Locality. | From whom received. |
|----------|--------------|--------------------------|---------------------|
| 4042 | 1 | Astoria, O. | Acad. Nat. Science. |
| 4711 | 1 | Simiahmoo. | A. Campbell. |
| 4054 | 2 | Puget Sound. | Dr. Suckley. |
| 4035 | 2 (larva) | Wash. Terr. (Aug. 1.) | Dr. Cooper. |
| 5982 | 14 | Chiloweyuck Lake, Or'g | Dr. C. B. Kennerly. |
| 5248 | 1 | Walla Walla, Ft. Benton. | Lt. Mullen. |

AMBLYSTOMA PAROTICUM Baird.

Spec. nov.

This Salamander is of very peculiar character. It is one of the stout-bodied species, in this respect about equal to *A. punctatum*, but with a broader head.

In the type specimen (4708) the skin is remarkably free from pits, pores and milk glands. These are found on the parotid region, both above and below the horizontal furrow from eye to side of neck, which is swollen in consequence. There is also a small patch on top of head, bordering the orbit; a patch on the spaces between the intercostal furrows, on the upper part of the sides, extending, though faintly, nearly to the belly. Along the ridge of the tail, bordered below by an indented line, the glands are thickly crowded. A few scattered glands are seen along the back. Elsewhere the skin is perfectly smooth and glandless, with the muscle directly beneath it, although probably when fresh the usual shallow pits of the group stud the skin thickly everywhere, as usual. These are distinctly visible in a second specimen, 4709. In this, also, the glands are more numerous on the back, and extend farther down the side of the tail.

The head is broad and depressed; considerably constricted at the neck. The eyes are unusually large and prominent for the genus; separated anteriorly by about twice the length of their orbits; distant from the nostrils less than this length. The outer and inner nostrils are respectively about equidistant by little more than one length of the orbit.

The tongue is moderate, nearly orbicular, filling the rami only anteriorly, and hardly more than half the width of the head.

The teeth are in four patches, forming a transverse series, slightly angular anteriorly, where they extend to about opposite the centres of the inner nostrils. The two central patches are rather the larger, with a slight interval. They extend postero-laterally nearly to the inner margin of inner nostrils; these are separated from the outer patches by an interval nearly the width of the inner nostrils. The lateral patches extend a short distance beyond the outer margin of the inner nostrils. The sphenoidal portion of the roof of the mouth is much restricted laterally and behind.

The body is full, rounded and depressed; there are eleven costal furrows, including inguinal and axillary.

The tail is compressed, but oval in cross section, with the lower edge rather sharp towards the end; the upper outline is much rounded. It is not high, and not as long as the rest of head and body; longer than from snout to groin. In one specimen there is a distinct furrow along the under side.

The limbs are large; the digits lengthened, more depressed than in *A. punctatum*, but linear, not triangular in shape. The lateral ones are more lengthened than usual, and those of each limb are more nearly of a length. The free portion of longest finger is more than one-third from tip to elbow; that of longest toe in the same proportion.

The gape of the head is wide; the length more than half the width. The width of the head is contained four times in distance from snout to groin.

The color in one specimen is everywhere a dull reddish olive or brown, paler beneath, and without the trace of any spots. No. 4707 is much darker—nearly black.

The *Amblystoma trisruptum* Cope, from Ocate Creek, is similar to the

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present species in the intervals between the *four* palatine patches and the glands on the parotid region. The rest of the skin, however, as far as can be ascertained, is glandular, as in *A. punctatum*, *tigrinum*, etc. The digits, too, are shorter, flatter, more irregular, the lateral and central more unequal; the eyes are much smaller and farther apart; there are 12 costal furrows, not 11, etc.

Proportional Dimensions.

| | |
|--|----------------------|
| Length of gape of mouth, to its width..... | more than half. |
| Width, to distance from snout to gular fold..... | cont. $1\frac{1}{4}$ |
| groin | $4\frac{1}{2}$ |
| behind anus..... | +5 |
| From snout to gular fold, contained in distance from snout | |
| to groin | $3\frac{1}{2}$ |
| behind anus | +4 |
| Distance anteriorly between eyes, in length of orbit..... | 2 |
| from eyes to nostrils.... | little over 1. |
| between external nostrils..... | " 1. |
| internal nostrils | about 1. |
| Width of tongue to width of head | little over half. |
| Free portion of longest finger contained in distance from | |
| elbow to tip | $2\frac{2}{3}$ |
| Distance between outstretched toes in length from snout to | |
| groin | equal. |

Measurements.

| | |
|--|------|
| Length (measured along axis of body) from snout to gape..... | .50 |
| gular fold | .95 |
| armpit..... | 1.50 |
| groin | 3.10 |
| behind anus..... | 3.80 |
| end of tail..... | 7.20 |
| Width of head | .75 |
| tongue | .40 |
| Length of orbit..... | .25 |
| Distance between eyes anteriorly..... | .45 |
| outer nostrils..... | .25 |
| inner nostrils..... | .24 |
| Height of tail where highest..... | .45 |
| Breadth " "..... | .20 |
| Free portion of longest finger..... | .30 |
| From elbow to tip of longest finger | .83 |
| Free portion of longest toe..... | .35 |
| From knee to tip of longest toe..... | 1.00 |
| Distance between outstretched toes | 3.05 |

| Cat. No. | No. of Spec. | Locality. | From whom received. |
|----------|--------------|------------------------------|---------------------|
| 4708 | 1 ♀ | Chiloweyuck, W. T. (1859) | A. Campbell (type). |
| 4708 | 2 | Near Simiahmoo. | " |
| 6634 | 1 | Coal mines of Vancouver Isl. | Alden W. Hewson. |
| 7021 | 1 | Puget's Sound. | Dr. Kennerly. |

AMBLYSTOMA ATERRIMUM Cope.

Sp. nov.

This is a stout species, having a form of head intermediate between that of the *A. tenebrosus* and *A. mavortium*. The dentition is quite peculiar, and with the ensemble of its characters, refers it to the immediate neighborhood of the *A. tenebrosus*.

Head a broad oval; its greatest width a little over $\frac{3}{4}$ the length from end muzzle to gular fold, and 4.2 in same to groin. The pupil marks three-sev-1867.]

enths the distance from canthus of mouth to external nostril. Fissure orbit equal length from same to nostril, and enters 1.66 times width between the latter; it is contained 2.25 times in width between anterior canthi of eyes. Canthus rostralis marked at orbit, terminating very obtusely at nostril; the profile descends steeply from line of latter, not being prolonged as in *A. tenebrosus*. Thus from the line connecting middle of inner nares to lip is .75 external internarial distance, and .6 between anterior canthus of eyes; in *A. tenebrosus*, same equals internarial width, and .75 the distance between eyes. The distances between inner and outer nares are the same; the former are round. The series of palatine teeth commence only opposite the middle of the posterior margin of the internal nares, and describe a slight curve round their inner margins to a point just in advance of their anterior, then turn abruptly inwards and slightly backwards, making a right angle with their previous course; they converge but do not unite.

Tongue large, as broad as long. Gular fold well marked; parotid groove not visible, perhaps accidentally. It is difficult, as in the *A. tenebrosus*, to distinguish the costal folds; there are not more than 12.

The tail is short and stout; its upper edge is much compressed, as is the posterior half; its glandular structures are much less developed than in other species of *Amblystoma*, the crypts of the crest being minute and globular. Length of tail equal from its origin (posterior margin vent) to posterior outline of sternum.

The extremities are very stout, just meeting when laid along the side. The palms and soles are very wide, and the toes short and flattened; they stand, as regards length, behind 3—4—2—5—1; before 3—2—4—1.

The color is black above, lead-colored below.

| | In. | Lin. |
|---|-----|-------|
| Length from snout to gape (flat proj.)..... | | 7.1 |
| gular fold | | 12.75 |
| axilla..... | | 19.1 |
| groin | | 39. |
| end of vent..... | | 48. |
| end tail | 6 | 6. |
| Width of head..... | | 9.75 |
| tongue | | 5.2 |
| between eyes anteriorly | | 5. |
| nostrils..... | | 4. |
| inner nostrils..... | | 3. |
| from eye to nostril..... | | 2.25 |
| Circumference belly | | 23.6 |
| Greatest height tail..... | | 5.4 |
| width " | | 4.5 |
| Free portion longest finger..... | | 2.5 |
| From elbow to tip of do.. .. | | 9.75 |
| Free part longest toe..... | | 3. |
| Knee to tip of do..... | | 11. |
| Extent of outstretched toes..... | 3 | 3.1 |

No. 5242. From North Rocky Mountains. Lieut. Mullen.

AMBLYSTOMA TENEBROSUM Baird and Girard.

Pr. A. N. S. Phila. 1852, 174. U. S. Exp. Ex. Rept. p. 14, Tab.

This species forms the type of a special section of the genus, differing as it does from all other *Amblystomata* of North America. It is especially characterized by its massive frame and huge size among true Salamanders, as well as by other peculiarities hereafter to be mentioned.

The corrugation of the skin prevents any critical examination of its character in respect to glands, pits, etc. It is certainly less glandular than in *A.*

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punctatum or *luridum*, although scattered glands may be detected closely and evenly distributed on the whole back and sides and on the chin: the remaining under parts and snout before the eyes are smooth.

The head is very massively built; large; broadest behind the eyes and triangular; the sides being nearly straight to the narrow and rounded tip. The eyes are very large and prominent, separated by less than two lengths of the orbit, and distant less than one length from the outer nostrils, which are separated by $1\frac{1}{4}$ orbits distance, and placed on the side below the distinct canthus rostralis. The outer nostrils are much more distant than the inner, which are very large, much excavated and have the external canal occupied by a soft plaited membrane.

The tongue is thick and fleshy, nearly orbicular; but angular anteriorly. It fills up the lower jaw pretty well, and is more than half the width of the head.

The palatine teeth are in two patches only; each very slightly convex anteriorly, coming together at a slight angle with the apex backward, but separated along the median line. Laterally the patches of teeth form the posterior margin of the inner nares, and do not extend beyond their outer margin. The entire series is thus posterior to the nostrils. In younger specimens the series are more transverse, the inner extremities slightly incurved.

The width of the head is contained $1\frac{1}{3}$ times in distance to gular fold, and 4 times to groin.

The body is rounded and depressed. There are 12 costal furrows.

The tail in the two specimens before me is considerably less than half the total length. It is much compressed from near the base, and the edges near the end are quite sharp. It is far short of being as deep at the base as the body.

The limbs are stout; the digits, the fingers especially, are short, considerably depressed, but linear and blunt at the tip; the under surfaces of these are somewhat swollen into a kind of bulb, which in alcohol contracts into something the appearance of a disk. The third finger is longest, but is very little more than the 2d, and this than the 1st and 4th. The third finger is contained nearly 4 times in the distance from elbow to tip. The 4th toe is longer than 3d in three specimens, in one the 3d exceeds the 4th a little, and the same are nearly equal in case of the fingers.

The color of this species in alcohol is a kind of dark reddish-brown, pale beneath, mottled and marbled above and on the sides with darker brownish; most distinct on the head, especially on the snout, where the skin is perfectly smooth. The head shows a tinge of greyish in the ground color.

(For fresh color see the figure in Girard's Herpetology of the United States Exploring Expedition.)

There are two varieties of this species :

a. Where the loreal region is flat and the muzzle narrower before the orbits, and the marblings confined to the head; the body being of a nearly uniform brown; represented by specimens 4710 and 4053.

β. The loreal region swollen in front of orbits, and hence the muzzle broader; the ground color greyish, with coarse brown marbling, like large hollow spots, distributed over the whole upper surfaces of the body and tail. Represented by No. 5981, and a large specimen (length 8 in. 6 lin.) in Mus. Academy Nat. Sciences, from Body Bay, lat. 38° 18' N., on the coast of California, procured by our esteemed correspondent, George Davidson.

Proportional Dimensions.

| | |
|---|----------------------|
| Length of gape of mouth, to its width..... | $\frac{2}{3}$ |
| Width contained in distance from snout to gular fold..... | $1\frac{1}{4}$ |
| groin..... | 4 |
| From snout to gular fold, contained in distance from snout to groin..... | little over 3 times. |

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| | |
|---|----------------------------|
| Distance anteriorly between eyes, in length of orbit..... | not quite twice. |
| from eyes to nostrils | four-fifths. |
| between external nostrils | $1\frac{1}{3}$ |
| internal | four-fifths. |
| Width of tongue, to width of head..... | $\frac{1}{2}$ |
| Free portion of longest finger contained in distance from elbow to tip..... | nearly 4 times. |
| Free portion of longest toe contained in distance from knee to tip..... | " $3\frac{1}{2}$ " |
| Distance between outstretched toes in length from snout to groin..... | $1\frac{1}{3}$ |
| Length of tail from behind anus, to rest of animal..... | contained $1\frac{1}{2}$ " |
| total length..... | two-fifths. |

Measurements.

| | |
|--|------|
| Length (measured along axis of body) from snout to gape..... | 80 |
| gular fold | 1.50 |
| armpit..... | 2.10 |
| groin | 4.55 |
| behind anus..... | 5.65 |
| end of tail | 9.30 |
| Width of head..... | 1.15 |
| tongue..... | .60 |
| Length of orbit..... | .34 |
| Distance between eyes anteriorly..... | .58 |
| outer nostrils | .40 |
| inner nostrils..... | .30 |
| from eye to " | .26 |
| Circumference of belly..... | 4.00 |
| Distance between armpit and groin..... | 2.65 |
| Height of tail where highest..... | .65 |
| Breadth do. | .36 |
| Free portion of longest finger..... | .28 |
| From elbow to tip of longest finger..... | 1.05 |
| Free portion of longest toe..... | .36 |
| From knee to tip of longest toe | 1.35 |
| Distance between outstretched toes..... | 3.60 |

| Cat. No. | No. of Spec. | Locality. | From whom received. |
|-----------|--------------|-------------------|-------------------------------------|
| 4710 | 1 | Oregon. | Ex. ex. (type). |
| 4053 (34) | 1 | Mo. of Columbia. | Lt. Trowbridge (spec. desc. above). |
| 5981 | 1 | Chiloweyuck Lake. | Dr. C. B. Kennerly. |

AMBLYSTOMA TEXANUM Baird.

U. S. Mex. Bound. Survey, ii. Reptiles 27 Tab., xxxv. 15. *Salamandra texana* Matthes, Allg. Deutsche Nat. Zeitung i. 266, 1855.

The description of this species is taken from specimens which are not fully grown; the proportions are, however, much those of the *A. microstomum* at the same age; this with the large number of costal grooves renders it almost certain that the full grown individuals are much like those of the latter species, and very probably of near the same size.

Skin everywhere quite smooth, no trace of pores on the head or parotoid region in many specimens. Costal folds fourteen, distinct; head folds slightly marked, the gular slight. A median dorsal groove.

Head oval, rather flattened and broad, canthus rostralis somewhat marked. Mouth large, canthus behind eye, anterior canthus of latter marking middle of margin. Nostril a little nearer eye fissure than length of latter, probably equal in older specimens. Width between anterior canthus of eye double

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length of fissure ; external separated by one length of same, which is less than the distance between inner nares.

Tongue small as in other young, but not fissured or grooved as in those of the two following *Amblystomæ*. Palatine teeth forming an arched series between nares extending to their anterior border, and not beyond their inner border in the lateral direction. From their resemblance to those of *A. microstomum* of the same age I suspect they are similar in old individuals.

Body rather slender ; width of head at jaws four times in total length to groin and .75 length to gular fold. Tail short, longer when older, equal from its basis to axilla. Limbs moderately stout, digits elongate, third and fourth toes nearly equal, then 5th, 2nd, 1st. Fingers 3, 2, 4, 1.

Above light brown, with a series of light spots along upper part of sides ; these are small and one between each pair costal fold. Sides and belly yellow.

| | In. | Lin. |
|--|-----|------|
| Length end muzzle to canthus oris..... | | 2.6 |
| to axilla..... | | 6.5 |
| to groin..... | | 14. |
| to end tail | 2 | 3.75 |
| elbow to end finger..... | | 3.1 |
| knee to end toe..... | | 3.7 |

| Mus. No. | No. Specimens. | Locality. | Collector. |
|----------|----------------|---------------------|---------------|
| 4044 | 11 | San Antonio, Texas. | J. D. Graham. |

The plane front and canthus rostralis of this species form a resemblance to the *A. tenebrosus*, between which and *A. microstomum* it is naturally placed.

AMBLYSTOMA CINGULATUM Cope, sp. nov.

This species approaches the *A. microstomum* in general, but may be readily known by its more elongate ovoid head, with long muzzle, more slender form of body and peculiar coloration.

Mucous crypts and pores are not much developed in this animal, a few only of the latter extend along the superciliary region. The costal folds are visible across the abdomen.

The head is elongate, convex both transversely and longitudinally ; the upper face of the muzzle is narrowed, and projects beyond the mandible. The width at the jaws enters the length to the groin six and a half times, and one and three-fourths to the edge of the gular fold. The external nares are quite close together, nearer than the long diameter of the eye, and nearly 1.5 this diameter in advance of the eye. The anterior angles of the latter are 2.33 diameters apart. The folds on the side of the head and neck are as in other species. The distance between the inner nares is 1.66 times the distance between the external.

The tongue is oval, quite elongate, but not filling the space between the rami of the mandible ; its median groove strongly marked. The palatine teeth are in a single row slightly convex forwards, entirely between the inner nares, their posterior margins of the ends of the series and nares corresponding. The gape of the mouth is short, but longer than in *A. microstomum* ; its external canthus falls anterior to the posterior canthus of the eye, while the anterior canthus of the same measures the posterior third of the gape, commencing at the middle of the premaxillary region.

Costal grooves fourteen ; a median dorsal groove strongly marked. An unusually strong fold across between angles of mandible, which sends a branch to the orbit ; gular fold continued on neck, sending a parotoid groove forwards. Length to gular fold 3.75 in length to groin.

Length of tail nearly equal from basis of same to the mental cross fold. It is of rather uniform depth, much compressed, keeled above and for its distal half below. General form of the body slender and compressed, elevated at the scapular and pelvic regions.

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Limbs stout, the fingers slender but not very elongate. Appressed to the sides they fail of meeting by the length of the sole and longest toe; length from tip to tip when outstretched .66 length to groin. Length of lower leg and foot scarcely .8 from muzzle to gular fold. No visible plantar tubercles. Fourth toe distinctly longer than third, then 2, 4, 1. Fingers 3, 2, 4, 1.

Color in alcohol black, the under surfaces thickly speckled with grey. A vertical narrow grey line passes between every pair of costal folds and meets its fellow on the dorsal line or bifurcates to meet a similar bifurcation in like manner, embracing an area. These narrow annuli extend nearly as far forwards as the orbits and surround the tail to its extremity. Muzzle black.

| | In. | Lin. |
|--|-----|------|
| Total length..... | 3 | 6. |
| Length to canthus oris (straight)..... | | 2.25 |
| gular fold..... | | 6. |
| groin | | 18.7 |
| Width of head..... | | 3.2 |
| above femora..... | | 2.25 |

The shades of coloration in this creature are those of the *A. opacum*, but are differently arranged.

No. 3786; 1 spec. Grahamville, S. Ca. Bailey.

AMBLYSTOMA MICROSTOMUM, Cope.

Proc. Ac. Nat. Sci. Phila., 1861, p. 123. "*Salamandra porphyritica* Green," Hallowell (not of Green), hinc *Amblystoma porphyriticum* Hallowell. Proc. A. N. Sci. 1856, p. 8.

This species is among the most slender of American *Amblystomata*, and has other peculiarities by which it is readily recognizable. The skin is very smooth and slippery, with the glands less evident in the skin than in *A. opacum jeffersonianum*, etc. The skin is everywhere covered with small shallow pits only visible when the mucus is removed, which shows the tail to be sometimes conspicuously granulated, the granules probably corresponding to the ends of the glands. There are no evident pores or pits of larger size than the others on the head and parotids as in some *Amblystomata*.

The head is very small, narrower than the body, with little or no constriction at the neck. It is contained about six and a half to seven times in the distance to the groin. The head is much arched in every direction; the eyes far forward and lateral. The lower jaw projects a little beyond the border of the upper, concealing the latter when viewed from above. The eyes are distant, less than the length of the orbit from the nostrils; their anterior extremities separated by one and a half times this unit. The nostrils are one orbit length apart. The anterior edge of the orbit falls opposite the middle of the gape, instead of in its posterior third, as in *A. jeffersonianum*. The gular fold is distant from the snout one-fifth the distance to the groin.

The body is slender for the genus. There are fourteen costal furrows, including the inguinal and axillary. There is a slight indication of a dorsal groove posteriorly.

The tail is about two-thirds the head and body. It is nearly cylindrical at base; then becoming slightly compressed, more and more so to the tip, where it is quite flat, but without crest, although the edges are sharp. Viewed from the sides, there is a constriction at the base of the tail; this is one-fourth higher in the middle than at the base.

The limbs are weak, the digits are, however, rather long, cylindrical depressed, without membrane. The proportions of the digits as in *A. punctatum*. The longest finger is not one-third the fore arm; the longest toe is a little more than one-third the leg from knee. The outstretched hind legs are about two-thirds the head and body to groin.

The tongue is thick, fleshy and attached, although slightly free at sides and

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tip. There is a longitudinal groove in the tongue, separating the two papillose portions of an oval shape placed side by side. This has not been observed in *jeffersonianum*. The pappillæ form parallel series on each oval oblique to the central groove with the edge of the tongue projecting beyond them.

There are only two patches or lines of palatine teeth. These occupy the middle of the palate, forming a Δ , the angle anterior and reaching as far forward as the anterior border of the inner nares; the postero-external ends do not pass the inner margin of these nares (in the soft palate, the proportions being a little different in the skull.)

Sometimes these two patches form nearly a straight line; or at least the central portion is straight, the lateral bending slightly backwards.

The color in alcohol is a dark brownish black, a very little paler beneath, and thickly and irregularly sprinkled on the sides with plumbeous spots about the size of the eye of no definite outline. These are less numerous above and below. Sometimes nearly wanting—sometimes they are larger than as described and look not unlike patches of a grayish lichen growing on the sides.

| | |
|--|------|
| 4096 (1.) Length (along axis of body) from snout to angle of mouth.... | •20 |
| gular fold..... | •45 |
| groin..... | 2•20 |
| behind anus..... | 2•50 |
| tip of tail..... | 4•00 |
| of tail..... | 1•50 |
| Width of head..... | •31 |
| Fore arm from elbow..... | •40 |
| Leg from knee..... | •46 |
| Expanse of hind legs..... | 1•45 |

The total length of largest specimen seen (3999 St. Louis) is six inches, of which the tail forms 2•60. The smallest adult is two inches long.

In the just perfected young is seen a series of larger illy-defined light spots than elsewhere along each side of the back. The belly is quite light colored.

This species bears a close resemblance to *Plethodon glutinosus*, for which the generic peculiarities, the longer digits, etc., readily distinguish it. The bluish spots too are much less sharply defined and duller, less silvery, and do not occur on the back, as in *glutinosus*, to anything like the same extent. From *A. jeffersonianum* it will be known by the projecting lower jaw; much smaller and more arched head, greater number of costal furrows, more evident spots on the sides, etc., besides the important peculiarities of tongue and teeth.

This is one of the species whose metamorphosis is completed some time before it attains full size. A specimen in which minute stumps of the branchiæ remain measures 2 in. in length; another, without traces of them, 2•15 in. The width of the head enters the length to the groin 4•2 times, and the tail falls short of the axilla from its base. These measurements may be compared with those of the adult, in illustration of the general principle that the relative lengths of body and tail increase with increased size.

| Cat. No. | No. of Spec. | Locality. | From whom received. |
|----------|--------------|------------------------|-----------------------------|
| 4096 | 30 | South Illinois. | R. Kennicott (spec. descr.) |
| 3902 | 4 | New Madrid, Mo. | " |
| 4001 | 2 | Lancaster, Ohio. | L. Lesquereaux. |
| 3995 | 3 (2 larv.) | Columbus, " | " |
| 3999 | 2 | St. Louis. | Dr. Engelman. |
| 4037 | 1 | Fort Smith, Ark. | Dr. G. C. Shumard. |
| 3884 | 5 | Prairie Mer-Rouge, La. | J. Fairie. |
| 4687 | 2 | Grand Coteau, La. | St. Charles College. |
| 3949 | 6 (juv.) | New Madrid, Mo. | R. Kennicott. |

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In concluding the review of this genus I wish to criticise the following remarks, published by F. P. Pascoe in Proc. Zool. Soc. London, 1866, p. 223:

"With many naturalists I believe the idea still remains that every genus must have certain definite structural peculiarities, and they appear to expect that broadly dividing lines shall run between them. Any confession that no absolute or primary characters exist, or that they are only secondary, is taken by them as a fatal proof of the weakness of the position. It is true that, owing to the more or less exceptional isolation of many genera, a very clear and decisive description may be given of them; but then it can never be said how soon the discovery of another form or species may upset the characters we have drawn from our limited number of examples, or whether the new genus or species may not be other sex of some other species. Moreover there are many natural assemblages of species, whether we choose to call them genera or not, for which no technical characters can be found, their connection depending partly on peculiarities which it is scarcely possible to convey an adequate idea of in words, partly on such gradual modifications of characters that no satisfactory line can be drawn between them, but which are, notwithstanding, not less real or striking. Those who only select a few prominent forms for description may demur to this; but any one who has gone conscientiously through a large collection will acknowledge how difficult it is in many instances to say if genera really exist, even as a collective term for any limitable number of species, and how unsatisfactory is any attempt to combine species into genera, or individuals into species, or to distinguish hybrids from what we conventionally call true species. It will therefore be readily understood that many genera can only be vaguely defined, either from the absence of salient characters, or from their gradual modifications; and some of the most natural groups among the Coleoptera might be cited as examples of these classes. To argue that genera ought to be ignored, when not strictly defined, would, in entomology, be to make classification impossible; to say that recognized genera should be enlarged from time to time to admit aberrant forms would be merely to create repertoires of incongruous species."

When we read "that genera can only be vaguely defined, from the absence of salient characters or their gradual modification," it is evident that there is a contradiction in terms, or that a new definition of a genus has been adopted. Are scientific men prepared to accept the above definition of a genus? We suspect not, for with it the translation of the natural system becomes merely empiric, and that exactitude which characterizes nature vanishes from its written counterpart. A genus, in our estimation, is a series of species distinguished from all other species by one or more structural characteristics, which are not variable in the reproducing adults of that series, or of any other series of species, *not otherwise distinguished*. A genus so defined constitutes one, or most frequently several series of species, bearing a successional relation to each other, which may differ widely in general appearance, coloration, etc., and which are frequently mistaken by zoologists for genera. They are "the assemblages of species, which are not less real or striking," to which our author alludes. I would correct the allusion by calling them assemblages of species which *are less real*, though *not less striking*.

An error of this kind, or else a want of exhaustive investigation of structure, most probably a combination of both, has no doubt led to the opinions I have quoted above. A rigid classification of characters into essential and non-essential, is what our science everywhere needs. But taking the opposite course, written zoology becomes a panorama rather than an analysis. Were the principles of classification employed by some authors to be applied to domesticated animals, its errors would be obvious to every one.

The genus occupying the preceding pages is an illustration in point. Had the author adopted the various supposed species and genera described

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which it includes, he might have readily been brought to the necessity of according with the views above quoted. But a correspondence with nature has required the recognition of *protean* species, as in a higher grade of characters we are compelled to recognize protean genera. These groups are, perhaps, those in which, respectively, certain characters are, for the time being, undergoing a transition, which transition may at some period cease.

The serial relation of species has been above alluded to. This is far less obvious, however, than the serial relation of genera. This does not, however, interfere with the entire isolation of the latter from each other as regards any single geologic period, considered by itself. The naming of groups of species which do not present this isolation, though prevalent in some branches of zoology, is, in our estimation, a violation of the meaning of the name genus, and very disadvantageous to science. It is, of course, of no consequence to science whether a genus contains one or a thousand species, and for the student they can be as well classified and characterized in the latter case as the former. In the multiplication of names a new burthen is imposed—but what shall we say when these come to apply to something “vaguely defined,” or “for which no technical description can be found”!*

II. *Species of AMBLYSTOMA unknown to the writer.*

Amblystoma punctulatum Gray, Catal. Batrachia Gradientia, Brit. Museum, 37, 1850.

Said to be from Monterey, California. The description is too brief to enable us to recognize or place it.

III. *Descriptions of two new Pacific species of PLETHODON Tsch.*

PLETHODON INTERMEDIUS Baird.

This new species, in general appearance, proportions of body, etc., is very similar to *P. erythronotus*, although abundant differences are easily discoverable. The body, as in *erythronotus*, is slender and depressed; the tail, as far as indicated by the portion still remaining, is slightly compressed.

There are no apparent peculiarities about the head. The tongue is elongated, elliptical, without posterior emargination. There are 14 costal furrows, or perhaps 15, if we include one above the axilla. The distance from snout to axilla is contained rather less than three times in that to groin.

The digits are well developed; more as in *P. glutinosus*. There is little if any indication of web at their bases; the three terminal phalanges of the 3d and 4th toes being free. The 2d and 4th toes are about equal. The outer toe is not more than half the 2d; the 1st finger and toe are almost rudimentary. The 3d finger is decidedly longer than the 2d.

The dorsal surface of this species is traversed by a broad brownish-red stripe, extending from the nape to the end of the tail, the sides regular and nearly parallel, though more separated towards the middle of the back, where it is as wide as the interorbital space. The stripe is sparsely dotted with dusky throughout its extent. The sides are abruptly blackish-brown on each

* Another example of this mode of procedure may be found in a classification of the Crocodilia, by Dr. Gray, in the Trans. Zool. Society, London, 1867, which only needs to be read to explain the applicability of the above remarks. The absence of all contrast in many of the generic tables is because they do not exist as such in nature.

It may be added in this connection that the writer omits dates of publication of the names of the genus *Osteolaemus* Cope, the latter having over a year priority over *Halcrosia* Gray, the name adopted. He calls the species *H. nigra* from the *Crocodylus niger* of Latreille, H. N. Rept. page 210 (not 510, as given by Gray), a species based on the MS. notes of Adanson, with the only description that it is black, and that its jaws are longer than those of the *Crocodylus* of the Nile. Should such a description be sufficient to establish a species, which we greatly doubt, it is enough to indicate its inapplicability to this present one, that the jaws of the *Osteolaemus tetraspes* are always much shorter than those of the *Crocodylus vulgaris*, a fact readily determined by reference to Dr. Gray's essay itself.

side the dorsal stripe, at first continuous, but becoming more and more interrupted by mottling. The belly is light brownish-yellow, thickly mottled with dark brown in about equal proportions; tightest under the chin. There is a dusky line from the eye to the point of the muzzle.

The general proportions and structure of this species are more those of *P. glutinosus* than of *erythronotus*, although slenderer of body. In both there are about 14 costal grooves. The outer digit in *intermedius* is nearly rudimentary instead of prominent, as in the other species.

A distinguishing feature, when compared with *cinereus* and *erythronotus*, is found in the 14 instead of 18 costal grooves, the fore and hind limbs being thus less widely separated proportionally. The legs are slender and the digits much less webbed (scarcely at all, in fact). The 3d and 4th toes, especially, are much longer.

Independent of the structural peculiarities I find nothing in the color to distinguish this species from *erythronotus*.

Measurements.

| | |
|--|------|
| Length (measured along axis of body) from snout to gape..... | 14 |
| “ “ “ gular fold | 45 |
| “ “ “ armpit... .. | 65 |
| “ “ “ groin | 1.80 |
| “ “ “ behind anus..... | 2.15 |
| “ “ “ end of tail..... | 3.65 |
| tail. | 1.50 |
| Width of head..... | .25 |
| tongue..... | .15 |
| Length of tongue..... | .24 |
| orbit..... | .09 |
| Distance between eyes anteriorly..... | .15 |
| Circumference of belly..... | .80 |
| Distance between armpit and groin..... | 1.25 |
| Height of tail where highest..... | .17 |
| Breadth do. | .16 |
| Free portion of longest finger..... | .07 |
| From elbow to tip of longest finger..... | .31 |
| Free portion of longest toe... .. | .11 |
| From knee to tip of longest toe..... | .37 |
| Distance between outstretched toes..... | 1.10 |

| Cat. No. | No. of Spec. | Locality. | From whom received. |
|----------|--------------|----------------------------|----------------------------|
| 4732 | 1 | Fort Tejon, Cal. | J. Xantus (type of descr.) |
| 6635 | 1 | Coal mines, Vancouver Isl. | Alden W. Hewson. |

PLETHODON CROCEATER Cope.

The largest species of the genus, and one of the most ornamented of the American salamanders.

In primary features this species is near the *P. ensatus* (*Heredia oregonensis* Girard,) having the attachment of the tongue along the median line, quite narrow, and a very narrow free margin in front. The palatine teeth form two long transverse separated arcs, which are directed more posteriorly at their median than exterior extremity, the latter extending further outside the outer margin of the inner nares than the transverse diameter of the same. The tail is subcylindrical and slender, compressed and narrowed in section below. No prominent glandular agglomerations or pores. Only three phalanges in the fourth toe.

Form of head peculiar; it is very broad, with straight converging maxillary outlines and truncate muzzle. Upper surface much narrowed on muzzle, loreal regions plane, very oblique, canthus rostralis not marked. Maxillary outline obliquely spread at and behinds orbits, where it is exceeded by the

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projecting margin of the mandible. Anteriorly, with the end of the muzzle it projects considerably beyond mandible. Muzzle truncate in profile, a slight emargination at middle of premaxillary border, and a groove on each side of it on inferior projecting face of lip. Nares terminal some distance above the angulation of the lip, continued below in a groove which bifurcates near lip margin; the posterior line extending a short distance, the anterior to the median emargination separating the anterior from the inferior plane of the muzzle. Eye large, not very prominent, its anterior canthus well in front of middle of jaw, and separated one diameter from nostril, and 1.5 from the other eye.

No fold across from angle to angle of mandible, but the gular, parotoid and postorbital grooves well marked. Costal grooves indistinct, thirteen. Skin everywhere very smooth.

Tail longer than head and body by the length of the mouth. Width at curve of mandible 4.6 times in length to groin. Extremities slender and long; when pressed to the sides the fingers extend to the heel. Length of whole fore limb 2.75 times in length to groin. Inner finger very small, half the length of the fourth; third longer than second. Sole narrow, longer than the longest toes. Inner toe less than one half the fifth; third a trifle longer than fourth; second much longer than fifth. Lower leg .75 thigh to groin.

Patches of parasphenoidal teeth two, in contact anteriorly, well separated from palatine. All the teeth minute, numerous, acute cylindro-conic. Tongue with rather straight lateral and posterior outlines.

Color throughout pitchy black, fading into bright red orange below; limbs orange, a blackish cross band below the knee. A large red orange spot on each parotoid region, and four smaller irregular similar spots on the body to base of tail, on each side of and near the vertebral line. A pair of orange spots at base of tail, and a distant series on the upper face of the tail.

Measurements.

| | In. | Lin. |
|---|-----|------|
| Length (measured along axis of body)..... | 5 | .11 |
| “ From snout to gape, (on front)..... | | .5 |
| “ “ gular fold..... | | .8 |
| “ “ armpit..... | 1 | 0.75 |
| “ “ groin..... | 2 | 5. |
| “ “ centre of anal slit..... | | 4.5 |
| Width of head..... | | 6.75 |
| “ tongue..... | | 3.75 |
| Length of orbit..... | | 2.2 |
| Distance between eyes anteriorly..... | | 3.3 |
| “ outer nostrils..... | | 2.3 |
| “ inner nostrils..... | | 2. |
| Height of tail where highest..... | | 3. |
| Breadth “ “ “..... | | 2.5 |
| Free portion of longest finger..... | | 2.25 |
| From elbow to tip of longest finger..... | | 7.25 |
| Free portion of longest toe..... | | 2.75 |
| From knee to tip of longest toe..... | | 8.5 |
| Distance between outstretched toes..... | 2 | 4.4 |

One specimen. Fort Tejon, Cal. J. Xantus.

The only genus omitted from my examination of the families of Urodela* is *Aneides* Baird. An examination of the skeleton shows that genus enters the *Plethodontidae* and is nearest *Plethodon*, but differs from it in having the mandibular teeth confined to the distal half, and exceedingly long and compressed, thus differing from all known *Urodela*.

* Journ. A. N. S. 1866.



Cope, E. D. 1868. "A review of the species of the Amblystomidae." *Proceedings of the Academy of Natural Sciences of Philadelphia* 19, 166–211.

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