

UNITED STATES GEOLOGICAL SURVEY OF THE TERRITORIES.

THE VERTEBRATA

OF THE

TERTIARY FORMATIONS

OF

THE WEST.

BOOK I.

By EDWARD D. COPE,
MEMBER OF THE NATIONAL ACADEMY OF SCIENCES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1883.

ix

DEPARTMENT OF THE INTERIOR.

REPORT

OF THE

UNITED STATES GEOLOGICAL SURVEY

OF

THE TERRITORIES.

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UNITED STATES GEOLOGIST-IN-CHARGE.

VOLUME III.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1884.

A dorsal vertebra, probably posterior, has a depressed centrum nearly square in outline viewed from below, with lateral concavities and obtuse median ridge. The articular surfaces are slightly opisthocœlous. A lumbar shows subcylindric postzygapophyses as in *Mesonyx*. A femur displays a well-developed third trochanter. The rotula is strongly elevated, much more so than in the species of *Mesonyx*. Immediately above it, the section of the shaft is subtriangular, the wide base posterior.

Measurements.

		M.
Diameters of centrum of a dorsal vertebra	vertical .....	.008
	transverse .....	.015
	anteroposterior .....	.017
Length of a lumbar vertebra .....		.024
Diameters of shaft of femur below third trochanter	anteroposterior .....	.011
	transverse .....	.017
Diameters at condyles	anteroposterior .....	.030
	transverse .....	.028

SUPPLEMENT TO PART FIRST.

THE AMYZON SHALES.

In the uncertainty whether this formation belongs to the Eocene or Miocene series, I introduce it between the two.

In the American Naturalist for May, 1879, I named the strata of this epoch, that of the Amyzon beds, from the characteristic genus which it includes, and referred it to the later Eocene or early Miocene eras. Its fauna includes twelve species of fishes, distributed as follows: *Trichophanes* Cope, 3 sp.; *Amyzon* Cope, 4 sp.; *Rhineastes* Cope, 1 sp.; *Amia* L., 2 sp.; and two of birds; (*Charadrius* and *Palæospiza*). These genera have not been found represented in the fish fauna preserved in the Green River shales, which embraces eight genera and twenty-four species. But they occur in several species and specimens in the South Park of the Rocky Mountains of Colorado, associated with the genera *Rhineastes* and *Amia*, neither of which has yet been found in the Green River formation. The first named is common in the Bridger, but in a different form, and the generic identity is not yet fully established. The *Amia* is represented in the Bridger by *Pappichthys*, but in the former genus the characteristic parts have not yet been seen in the South Park specimens, so that here also the

determination of the genus is not final. It however remains, that this fish fauna is different from that of the Green River beds, and the modern aspect of the genera points to an age even later than the Bridger. It is evident that the pertinence of this series of rocks to the Green River formation, asserted by King, cannot be maintained.

I published the first notice of this formation, which I examined at an exposure in the northeastern portion of Nevada, twenty-five miles northeast of Elko, on the Central Pacific Railroad. The outcrop is on the south side of the low mountain range bounding Humboldt Valley on the north. The beds are exposed in a drift and adjacent cutting, and a shaft 200 feet in depth. The strata are argillaceous and in some degree calcareous, and are very thinly laminated; so much so as to resemble thin brown or black paper in some portions of the series. They are highly carbonaceous, and burn freely; some of them with the odor of amber, which appears as a gloss on some of the laminæ. Descending 60 or more feet through these shales, we reach a bed of solid argillaceous material of a dark-green color. This can be removed with the pick, but hardens on exposure to the atmosphere. It contains fresh-water shells. The first bed of coal is two and a half feet in thickness, with one or two laminæ of slate. The second bed is 12 feet deeper, and is about 3 feet in thickness. In quality both resemble cannel, but have more luster.

Masses of the laminated shales resemble the braun kohle of Bonn, Prussia; and they contain fossils disposed in the same way. These consist of multitudes of leaves, mostly of dicotyledonous plants; of mollusks, insects, and fishes; the last two often in a fine state of preservation. The mollusks present forms similar to *Planorbis*, *Viviparus*, etc. The insects are mostly diptera, and some of them are nematocera. The fishes are fresh-water forms, of which, perhaps, four species were procured. I made an examination of two of these, and found them to represent both species and genera new to science. One of these is of interest, as furnishing the first evidence of the appearance of the *Catostomoid* type, now so extended in North America; the other is allied to a genus which has been discovered in the Eocene shales of Green River.

The shales are considerably less indurated in general than those of

Green River. They have been greatly disturbed by the elevation of the ranges bounding Humboldt Valley, as they dip nearly south, at an angle of forty-five degrees, at the mine.

The Tertiary shales of Florissant in the South Park of Colorado have already yielded numerous species of plants, insects, and fishes, which have been described by Messrs. Lesquereux, Scudder, and myself.* Six species of fishes have been determined, three of which pertain to the same genus of *Catostomidæ*, which I had previously procured from the paper coal of Osino, Nevada. On this ground, an approximation of the horizons of the two localities was made. I have recorded the occurrence of a species of the second genus found in the Osino coal, *Trichophanes*, of which the *T. hians* had been up to that time the only one known. The epochal identification of the two formations was thus confirmed.

The other species of fishes known belong to *Amia*, *Amyzon* Cope, and *Rhineastes* Cope, members of the sucker and catfish families, respectively. Both genera are nearly allied to existing forms, and the addition of the *Amia* increases the modern facies of the ichthyic fauna of the period in question. The discovery strengthens the evidence for the view that the waters inhabited by these fishes were completely isolated from access of salt or brackish water, thus differing from the beds of the Green River epoch, and occupying a later position in the scale of periods.

The regions of the John Day River and Blue Mountains furnish sections of the formations of Central Oregon. Above the Loup Fork, or Upper Miocene, there is a lava outflow, which has furnished the materials of a later lacustrine formation, which contains many vegetable remains. The material is coarse, and sometimes gravelly, and it is found on the Columbia River, and I think also in the interior basin. Professor Condon, in his unpublished notes, calls this the Dalles Group.† It is in turn overlaid by the beds of the second great volcanic outflow. Below the Loup Fork follows the Truckee Group, so rich in extinct mammalia, and below this a formation of shales. These are composed of fine material, and vary in color, from a white to a pale brown and reddish-brown. They contain vegetable remains in excellent preservation, and undeterminable fishes.

* Bulletin U. S. Geol. Surv. Terrs. 1875, n. 1, 3.

† I have published this in the Proceedings of the American Philosophical Society 1880, p. 61.

The *Taxodium* nearly resembles that from the shales at Osino, Nevada, and on various grounds I suspect that these beds form a part of the "Amyzon Group" (American Naturalist, June, 1880), with the shales of Osino and of the South Park of Colorado.

PISCES.

HALECOMORPHI.

AMIA Linn.

Two species of this genus have been found in the Amyzon shales. None of the specimens are as large as the *Amiidæ* from the Bridger formation.

AMIA SCUTATA Cope.

Bulletin U. S. Geol. Survey Terrs., 2d Series, 1875, p. 3.

Plate LX: fig. 1.

Represented by a specimen which lacks the head and body anterior to the middle of the long dorsal fin. The anal and part of the dorsal fin and the heterocercal tail are well displayed. The species differs from the existing *A. calva*, L., and its cotemporary *A. reticulata*, in the large size of its scales, of which only seven and a half longitudinal rows are visible above the vertebral column. The radii of the anal fin number nine, and the caudal vertebræ forty-six; caudal hæmapophyses number twelve.

Measurements.

	M.
Length from first caudal vertebra to end of caudal hæmapophyses	0.210
Depth of body at anal fin .....	.100
Length of base of anal fin .....	.023
Length of body of a vertebra .....	.005
Depth of body of a vertebra .....	.009

The specimen of the full size of the *A. calva*, is from near Florissant, South Park, Colorado.

AMIA DICTYOCEPHALA Cope.

Bulletin U. S. Geol. Surv. Terrs., 2d Series, 1875, p. 3.

Plate LIX; fig. 1.

Established on a number of specimens, but primarily on one in which the caudal and inferior fins are wanting, and only the posterior part of the

skull remains. A second consists of the entire cranium; a third, of the tail; and a fourth, of a specimen in good condition, lacking head and tail.

The first-mentioned specimen shows that there are ten or twelve rows of scales above the vertebræ, and that the dorsal fin commences about an inch behind the line of the posterior border of the cranium. It also exhibits the strong sculpture of the surfaces of the latter to consist of narrow inosculating ridges, inclosing large and smaller pit-areas.

The specimen exhibits this sculpture to be very marked on the opercular, suborbital, parietal, frontal, and sublingual bones, the only ones where it displays the surface. The branchiostegal radii number twelve, the upper large and wide. The subopercular is turned up anteriorly as in *A. calva*, and is thickened on the border of the suture with the interoperculum. The sublingual bone has much the form of that of *A. calva*, but is rather wider, and then more abruptly contracted than in a specimen of the latter before me. The orbit is smaller relatively than in *A. calva*.

It is uncertain whether this and the preceding species possessed the dentition of *Amia* or *Pappichthys* Cope, as the mandibular bone is partially and abruptly contracted near the apex, so the teeth may belong to the inner row of the true *Amia*, which is wanting in *Pappichthys*.

The fourth specimen displays the ventral fins and the characteristic femoral supports. The fins originate about an inch behind the line of origin of the dorsal fin in a specimen of 0^m.055 depth of body. The scales exhibit also the dermal margin with truncate posterior outlines seen in the existing species; this character is chiefly seen on the abdominal surfaces. There are thirty-five vertebræ between vertical lines drawn from the beginning of the dorsal fin and end of the basis of the anal fin, and thirty-two dorsal radii in the same interval; anal radii, nine; vertrals, six.

Measurements.

	M.
Depth of body to vertebræ (No. 1)	0.045
Length of four dorsal vertebræ (No. 1) .....	.019
Depth of one dorsal vertebra (No. 1) .....	.010
Length of head to free border of operculum (No. 2).....	.124
Depth of operculum of do.....	.032
Length of head on vertex .....	.093
Length from end of muzzle to orbit .....	.032
Length of orbit .....	.012

From South Park, Colorado.

NEMATOGNATHI.

RHINEASTES Cope.

Proceeds. American Philosophical Society, 1872, p. 486. Annual Report U. S. Geol. Survey Terrs. 1872 (1873), 638; supra, p. 60.

RHINEASTES PECTINATUS Cope.

Bulletin U. S. Geol. Survey Terrs., I, No. 2, 1874, p. 49.

Plate V, fig. 13.

This catfish is represented by a single specimen, which includes only the inferior view of the head and body anterior to the ventral fins. These exhibit characters similar in many respects to those of *Amiurus*, Raf, but the introperculum, the only lateral cranial bone visible, displays the dermo-ossified or sculptured surface of the Eocene genus, to which I now refer it. Other characters are those of the same genus. Thus the teeth are brush-like, and there is an inferior limb of the posttemporal bone reaching the basioccipital. The modified vertebral mass is deeply grooved below and gives off the enlarged diapophyses that extend outward and forward to the upper extremity of the clavicle. The patches of teeth are on the premaxillary, and are separated by a slight notch at the middle of the front margin. The teeth are minute. The four basihyals and the elongate anterior axial hyal are distinct; also the ceratohyal with its interlocking median suture. The number of branchiostegal radii is not determinable; three large ones are visible. The mutual sutures of the clavicles and coracoids are interlocking, and their inferior surfaces display grooves extending from the notches. The pectoral spine is rather small, and bears a row of recurved hooks on its posterior edge; there are none on its anterior face. The head is broad, short, and rounded in front, which with the uncinatè character of the serration of the pectoral spine, reminds one of the existing genus *Noturus*.

As compared with the five species of *Rhineastes*, described from the Bridger Eocene, the present species is distinguished by the small size, and large uncini of the pectoral spine.

Measurements.

	M.
Length of head to clavicle (below)	0.0130
Width of head (below) .....	.0360
Width of scapular arch (below) .....	.0110
Expanse of modified diapophysis .....	.0200
Length of modified vertebræ .....	.0115
Length of pectoral spine .....	.0210

From the Tertiary shale of the South Park, Colorado.

- PLECTOSPONDYLI.

AMYZON Cope.

Proceed. Amer. Philos. Soc., 1872, p. 480. Annual Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 642.

Allied to *Bubalichthys*. An open frontoparietal fontanelle; the premaxillary forms the entire superior arch of the mouth; the pharyngeal bones are expanded behind; there are twelve to thirteen rays of the ventral fin; there is a lateral line of pores which divides the scales, piercing their margin.

Dorsal fin elongate, with a few fulcral spines in front, and the anterior jointed rays osseous for a considerable part of the length. A few short osseous rays at front of anal fin. Scales cycloid. Caudal fin emarginate. Mouth rather large, terminal.

The characters of this genus are those of the *Catostomidæ*. There are three broad branchiostegals. The vertebræ are short, and the hæmal spines for the caudal fin are distinct and rather narrow. In one specimen a pharyngeal bone is completely preserved. It is slender, and with elongate inferior limb. The teeth are arranged comb-like, are truncate, and number about thirty to forty. The dentary bone is slender and toothless, and the angular is distinct. The premaxillary appears to extend beneath the whole length of the maxillary. Should this feature be substantiated, it will indicate a resemblance to *Cyprinidæ*. The maxillary has a high expansion of its superior margin, and then contracts towards its extremity. Above it two bones descend steeply from above, which may be out of position. The preoperculum is not serrate. The superior ribs are well developed. This form approaches in its anterior mouth, the true *Cyprinidæ*, through *Bubalichthys*. It was the first extinct form of *Catostomidæ* found in this country. Species more nearly allied to the existing ones are found in the Pliocene beds of Oregon and Idaho.

AMYZON MENTALE Cope.

Proceed. Amer. Philos. Soc., 1872, p. 481. Annual Report, l. c., 1872 (1873), p. 643.

Plate LIX, fig. 2, and Plate LX, fig. 2.

This fish occurs in considerable numbers in the Osino shales, and numerous specimens have been procured. Two only of these are before me at present. They are of nearly similar length, viz, M. .120 and .105. The most elevated portion of the dorsal outline is immediately in front of the dorsal fin. From this point the body contracts regularly to the caudal fin. The dorsal fin is long and elevated in front, and concave in outline, the last rays being quite short. They terminate one-half the length the fin in front of the caudal fin. The interneural bones are stout in front and weak behind. Dorsal radii III, 26, and (No. 2) (?) II, 23.

There are about twenty-three vertebræ between the first interneural spine and the end of the series in the former specimen, in which, also, there are no distinct remains of scales. In the second, scales are preserved, but no trace of the lateral line; there are six or seven longitudinal rows above the vertebral column.

The anal fin is preserved somewhat damaged; the rays are not very long, and number II, 7. The anterior interhæmal is expanded into a keel anteriorly. Ventral fins injured. The ribs and supplementaries are well developed. The inferior quadrate is a broad bone, with deep emargination for the symplectic. Depth No. 2 in front of dorsal fin, M. .025. Length basis of dorsal, .026.

AMYZON COMMUNE Cope.

Bulletin U. S. Geol. Surv. Terrs., Vol. I, No. 2, p. 50, 1874.

Plate V, fig. 21.

This is the characteristic fish of the Amyzon beds of the South Park of Colorado. In that locality it is the most abundant species.

The greatest depth of the body is just anterior to the dorsal fin, and enters the length 2.66 times the base of the caudal fin, or a little more than three times, including the caudal fin. The length of the head enters the former distance a little over 3.25 times. The general form is thus stout and the head short. The front is gently convex, and the mouth terminal. There are fifteen or sixteen rows of scales between the bases of dorsal and

ventral fins. They are marked by close concentric lines, which are interrupted by the radii, of which eight to fifteen cross them on the exposed surface, forming an elegant pattern. At the center of the scale the interrupted lines inclose an areolation. The extended pectoral fin reaches the ventral, or nearly so; the latter originates beneath the anterior rays of the dorsal, or in some species a little behind that point. They do not reach the anal when appressed. The anal is rather short, and has long anterior radii. The dorsal is elevated in front, the first ray a little nearer the basis of the caudal fin than the end of muzzle. Its median and posterior rays are much shortened; the latter are continued to near the base of the anal fin. Radii D. 33; P. 14; V. 13; A. 12. The caudal is strongly emarginate and displays equal lobes.

Measurements.

	M.
Length of a large specimen (10.25 inches).....	0.250
Length of medium specimen .....	.182
Depth at occiput of do. ....	.043
Depth at dorsal fin.....	.057
Depth caudal peduncle.....	.023
Length of head (axial).....	.044
Length to D. 1 (axial) .....	.075
Length to end of dorsal (axial).....	.131
Length to basis of caudal fin .....	.146
Length of basis of anal fin .....	.023

There are thirty-eight or thirty-nine vertebræ, of which nine are anterior to the first interneural spine, and fourteen between that point and the first caudal vertebra.

A very large number of specimens was obtained by Dr. Hayden and myself from the Tertiary shales of the Middle and South Parks, Colorado. They display but insignificant variations in all respects, and furnish a good basis of determination. They all differ from the *A. mentale* Cope, in the larger numbers of vertebræ and dorsal and anal fin radii, and greater prolongation of the dorsal fin.

AMYZON PANDATUM Cope.

Bulletin U. S. Geol. Survey Terrs., 2d series, 1875, p. 4.

Form very stout; the body deeper in relation to its length than in the known species of *Amyzon*; greatest depth just in front of dorsal fin, and two-fifths the length to basis of caudal. Length of head one-third the latter. Spines of premaxillary causing a protuberance above the end of the muzzle, as in many existing *Catostomi*. Mouth slightly inferior; end of muzzle

obliquely truncate in profile. Dorsal fin elongate, elevated in front; radii mostly short; caudal openly emarginate; anal not very elongate in either direction; ventrals below first rays of the dorsal. Radii, D., III, 31; A., II, 11. Scales, $\frac{10.12}{10.11}$, with concentric and radiating lines well developed. Vertebrae .6, 17, 10.

Measurements.

	M.
Total length.....	0.112
Length to basis of caudal.....	.093
Length to basis of anal (axial).....	.071
Length to basis of ventral (axial).....	.041
Depth of caudal peduncle.....	.015
Depth of anterior anal rays.....	.022
Depth at occipital crest.....	.030

In another rather larger specimen, which agrees with that above described, the lateral lines are well preserved.

From the South Park, Colorado.

AMYZON FUSIFORME Cope.

Bulletin U. S. Geol. Survey Terrs., 2d series, 1875, p. 5.

Represented by a very small fish, which exhibits fully ossified bones, but may be immature. It exhibits characters quite distinctive, although the caudal peduncle, anal fin, and opposite parts of dorsal, are wanting. The head is very perfectly preserved, and is of a regularly short conic form, with equal lips. The attenuated muzzle shows none of the obtuseness characteristic of the other Amyzons. Another peculiarity is seen in the ventral fins, which stand below the eighth instead of the first articulated dorsal ray. They are evidently in their normal position, and the ribs are undisturbed. The pectorals extend more than half way to the ventrals. There are seven neural spines in front of the first interneural, and sixteen between the latter and the first interhæmal. In this, as in the other species, the postclavicle is rather elongate and acute, and the parapophysial element of the anterior vertebral mass extends as far down as the line of the middle of the orbit.

Measurements.

	M.
Length of head.....	0.0095
Length to line of ventrals.....	.0180
Length to line of anal.....	.0239
Depth at first dorsal ray.....	.0105
Depth at occiput.....	.0070

From the South Park, Colorado.

PERCOMORPHI.

TRICHOPHANES Cope.

Proceed. Amer. Philos. Soc., 1872, p. 479 (July 29). Annual Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 641.

The premaxillary bone forms all or nearly all of the superior arcade of the mouth. There are a few rows of small equal teeth *en brosse* on the dentary bone. Four rather wide branchiostegal rays are visible in the specimen. The posterior superior angle of the operculum (which is displaced in the specimen) is drawn out into an acute short spine; otherwise the bones of the head are smooth. There is a row of small teeth *en brosse* probably on the palatine or pterygoid bone. The anterior vertebræ are unmodified, and the centra are not elongate. A strong acute spine supports the dorsal fin, and a similar one the anal fin, in front. There is an elongate postclavicle on each side, which extends parallel with the femur to the base of the ventral fin. The femur is divided; the external portion is straight, and extends to the clavicle, while the other portion is curved inward and forward, reaching the apex of the corresponding bone of the opposite side. Ventral radii, 8. The dorsal originates above the ventral fin. The scales are peculiar, and characteristic of the genus. They are very thin, and without or with minute sculpture. Their borders are fringed with long, closely-set, bristle-like processes, which correspond to the teeth of the ctenoid scale.

This genus, *Amphiplaga*, and *Erismatopteras* form a group which probably belongs to the family of *Aphrodediridæ*, which is represented in modern American waters. *T. foliarum*, the only one in which the parts are large enough and sufficiently well preserved for observation, exhibits the furcate character of the femora which characterizes the family in question among Physoclystous fishes.

The first described species is the *T. hians*, from Osino, Nevada; the *T. foliarum* and *T. copei* are from the South Park of Colorado. I do not possess a specimen of the last named, which was described by the Princeton paleontologists.¹ It differs from the *T. foliarum* in its smaller scales.

¹Pal. Report Princeton Sci. Expedition, I, 1878, p. 93.

TRICHOPHANES FOLIARUM Cope.

Bulletin U. S. Geol. Survey Terrs., IV, p. 73, 1878.

Plate LIX; fig. 4.

The scales extend on the cheeks and abdomen; there are nine or ten longitudinal rows above the vertebral column, and about sixteen below it. The head is moderately elongate, and deep behind. The mouth is subterminal, and the extremity of the premaxillary bone extended backward would reach about half way to the orbit. Ribs stout; neural spines slender. The interneurals visible number eleven, but the posterior part of the dorsal fin is wanting. These bones have thin anterior and posterior laminar expansions. The anterior interneural strikes the fifth vertebra from the head; between this one and the first interhæmal there are nine vertebræ.

Measurements.

	M.
Length of the head to first vertebra.....	0.028
Depth of head posteriorly .....	.022
Length of mandibular ramus.....	.013
Length to scapula.....	.035
Length to dorsal fin .....	.050
Depth at middle of dorsal fin .....	.023

From the Tertiary shales of Florissant, Colorado. Obtained by my friend Dr. S. H. Scudder, of Boston, collaborator of the United States Geological Survey of the Territories.

The *Trichophanes foliarum* is represented by a much larger individual than the *T. hians*, but which wants the posterior part of the body, including the caudal and part of the anal fin. The generic and family characters are, however, very clearly visible in the anterior portion of the skeleton.

TRICHOPHANES HIANS Cope.

Proceed. Amer. Philos. Soc., 1872, p. 480. Annual Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 642.

Plate LIX; fig. 3.

Vertebræ, D. 9; C. 15; six between interneural spine of dorsal, and interhæmal of anal fin. Raddi, D. II. (?) 6 (soft rays somewhat injured); A. II. 7; V. and P. not all preserved; caudal rays numerous, forming a deeply bifurcate fin. The ventrals reach a little over half way to the anal,

and the latter about half way from its base to that of the caudal fin. The dorsal fin, laid backwards, reaches the line of the base of the first anal ray. The first dorsal ray is a little nearer the end of the muzzle than the origin of the caudal fin. The muzzle is very obtuse, and if the specimen be not distorted, not longer than the diameter of the orbit. The gape extends at least to the posterior line of the orbit. The suborbital region is deep posteriorly.

In its present somewhat distorted condition the specimen measures in—

	M.
Total length	0.059
Head .....	.016
Vertebrae .....	.029
Caudal fin.....	.0142
Length dorsal spine .....	.008
Length anal.....	.008
Length of hair-like fringes.....	.0005

The coracoid is not wide; the postclavicle has a proximal conchoidal expansion, and a long slender shaft extending to the anterior extremity of the femora. Caudal fin furcate. Interneural spines wanting anterior to dorsal fin; those of the anterior rays very strong. Interhæmals of the anterior anal rays similarly strong. Caudal fin embracing one vertebra.

From the coal shales north of Osino, Nevada; obtained by the writer.

AVES.

Two species of birds have been obtained from the Amyzon shales, which are represented by very few specimens. The best preserved specimen found up to the present time is thought by the able zoölogist, J. A. Allen, to be a passerine bird of the family *Fringillidæ*, and he accordingly names it *Palceospiza bella*.* The second species was described by the writer as a plover, under the name of *Charadrius sheppardianus*.

The specimen includes three vertebrae anterior to the pelvis; the pelvis, with the vertebrae which it incloses, and the caudal vertebrae; both femora; the tibia and part of the tarsometatars of the right leg, with the greater part of the left tibia. One-half of the tail is preserved, the feathers lying in almost undisturbed relation. There are also various light and downy

* Bulletin U. S. Geol. Surv. Terrs., IV, 1878, p. 443, Pl. 1.

feathers of the base of the tail and adjacent parts of the body lying on the block, some in place, others loose.

The characters displayed by the bones and feathers are those of a species of the order *Grallæ* and tribe *Limicolæ* (*Totanideés* A. Milne Edwards). In the absence of important parts of the skeleton, it is not possible to ascertain the family characteristics, but it is more easy to assign the species to its genus. I cannot detect any features which forbid its reference to the genus *Charadrius* in the large sense. It presents important resemblances to the species of *Totanus*, but there are some reasons, to be mentioned later, why this reference is inadmissible. It is clear that there are various genera of *Scolopacidæ* to which it cannot be referred, on account of the form of its *ossa ischii*.

GRALLÆ.

CHARADRIUS L.

CHARADRIUS SHEPPARDIANUS Cope.

Bulletin U. S. Geol. Surv. Terrs., VI, p. 83, Feb., 1881.

Plate LIX, fig. 5.

Femur one-half the length of the tibia; nine caudal vertebræ; tail gently wedge shaped, apparently without color cross-bars. The preiliac vertebræ are distinct from each other and have only moderately elongate centra. The diapophyses are of moderate length and less width, and are truncate at the extremity. Those of successive vertebræ are connected by but few osseous ligamentous spicules. The caudal vertebræ are short and wide, and have short diapophyses, except the first, which has a long narrow diapophysis. The last three are in profile, and do not display hypapophyses. The plowshare bone is an elongate triangle, considerably produced to its superior angle. The basal cotylus for articulation with the centrum immediately in front, is well excavated.

The pelvis is short and rather wide posteriorly. The fossil presents a superior view of it, with both the pubic bones turning their external faces upwards. The external borders of the anterior plates of the ilia are broken

away, but enough remains of their inner portion to show their anterior extent. The postacetabular ridges diverge outwards and terminate in a prominent angulation of the posterior border, which is about equidistant between the vertebral border of the ilium and the externo-inferior border of the pubis. The posterior outline thus differs from that seen in various genera of *Scolopacidae*, where the angle is much nearer the vertebral border, and where a second angle is produced by a notch at the point of junction of the ischium. The pelvis of *Totanus* is, however, much like that of the present species. External to the angular projection described, the border is notched, and then turns posteriorly, forming a gentle curve, which continues from the ischium to the slender pubis. The pubis is long and very narrow, and extends well posterior to the ischium. It is of uniform diameter, and is not expanded distally. The ischiopubic foramen is long and narrow, about one-seventh as wide as long. The obturator foramen is about one-third the length of the ischiopubic, and is oval. A transverse line cutting the anterior border of the acetabulum divides the pelvis between the posterior angular projection of the ilium (the true crest, *vide* Gegenbaur) and the anterior extremity into two parts of equal length.

The leg bones are quite slender, and are similar in proportions to those of several species of *Charadrius* and *Totanus*. They are more slender than in various species of *Scolopax*, *Strepsilas*, *Tringa*, &c., and less so than in *Himantopus* and *Recurvirostra*. The former is just half as long as the tibia, and seen in profile is almost straight. The crest of the tibia is very prominent, but is not produced proximally. The distal extremity of the tibia and proximal part of the tarsometatarsus are so damaged as not to furnish satisfactory characters.

There are five rectrices visible in the specimen. Those which are in all probability median are the longest, while the external two are of equal length. This gives the outline a rather short wedge shape as the feathers lie closed. The expanded tail would be rounded, with a slight median angulation. The extremities of the feathers are rounded, and their whole structure is soft and delicate. The length of the longest rectrix is just about that of the tibia.

Measurements.

	M.
Length of the preiliac vertebræ	0.010
Length of centrum of first vertebræ .....	.0035
Length of sacrum .....	.021
Length of caudal vertebræ on curve .....	.0145
Length of plowshare bone to apex .....	.005
Length of ilium .....	.024
Length of ilium to acetabulum .....	.012
Length of ischium from acetabulum .....	.016
Length of pubis from acetabulum .....	.019
Width between posterior angles of ilia .....	.009
Length of femur .....	.024
Diameter of femur at middle .....	.003
Length of tibia .....	.047
Anteroposterior diameter at head .....	.006
Diameter of shaft at middle .....	.0027
Diameter of head of tarsometatarsæ .....	.004
Length of median rectrix from plowshare bone .....	.046
Length of external rectrix from plowshare bone .....	.040
Width of portion of tail preserved .....	.020

The strongly contrasted light and dark shades of color are not unfrequently preserved in the insects of this formation. I suspect that had the rectrices of this species originally displayed the alternating white and dark cross-bars characteristic of the *Totani*, some trace of them would be discoverable in the fossil, in spite of the fact that the entire feather is represented by carbon only. The brown tint of the specimen, both light and dark, is uninterrupted by pattern of any kind.

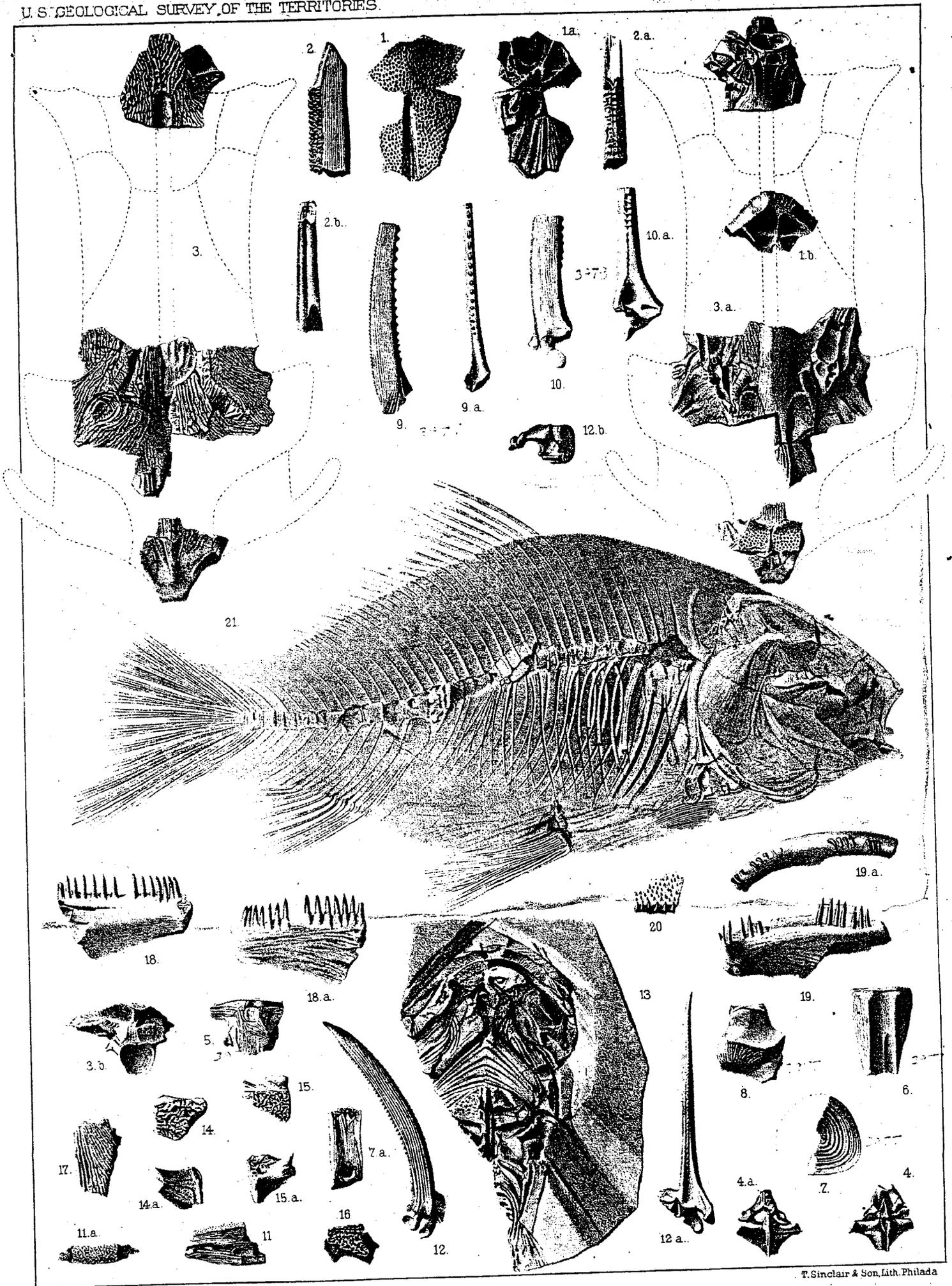
The tail is rather longer than in the *Tringæ*, about equal to that of many plovers and *Totani*, and shorter than that of *Actiturus*.

The *Charadrius sheppardianus* was discovered near Florissant, Colorado, by Dr. G. Hambach, a skillful naturalist. I have named it in honor of Edwin Sheppard, of Philadelphia, an excellent ornithologist and skillful artist.

PLATE V.

Fishes, natural size.

- Figs. 1, 2.—*Rhineastes peltatus*. Occipito-parietal bone, from above; the anterior extremity of contact with the frontal is entire; *a*, from below; *b*, from behind, showing the nuchal prolongation. Page 63.
- Fig. 2.—Dorsal spine, both ends wanting, left side; *a*, front; *b*, posterior aspect.
- Figs. 3, 4.—*Rhineastes calvus*. Page 65.
- Fig. 3.—Cranium inferentially restored from three fragments from the extremities, and anterior median portion; superior surface; *a*, from below; *b*, posterior view.
- Fig. 4.—Adjacent parts of dorsal spine and its supporting interneural bone.
- Figs. 5-11.—*Rhineastes smithi*. Three individuals represented by Figs. 5-9, 10, and 11, respectively. Page 64.
- Fig. 5.—Basioccipital from below.
- Fig. 6.—Anterior vertebral mass, from below.
- Fig. 7.—Dorsal vertebra, articular face; *a*, lateral view.
- Fig. 8.—Articular cotylus of mandible, from above.
- Fig. 9.—Pectoral spine, from side; *a*, from behind.
- Fig. 10.—Pectoral spine of another individual, from the side; *a*, from behind.
- Fig. 11.—Part of dentary bone of another specimen, external view; *a*, vertical view.
- Fig. 12.—Pectoral spine of *Rhineastes arcuatus*, lateral view; *a*, posterior view. Page 66.
- Fig. 13.—*Rhineastes pectinatus*. Inferior view of anterior part of skeleton. From Florissant, Colorado. Page 747.
- Figs. 14-17.—Fragments of skull of ? *Rhineastes radulus*, from near Fort Bridger. Page 67.
- Figs. 18-20.—*Dapedoglossus acutus*. Page 72.
- Fig. 18.—Left dentary, lacking the posterior portion, external view; *a*, superior aspect.
- Fig. 19.—Dentary bone of a second specimen, inner side; *a*, from above.
- Fig. 20.—Palatine bone of a third individual.
- Fig. 21.—*Amnyzon commune*. Typical specimen, from Florissant, Colorado. Page 749.



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1-17 RHINEASTES 18-20 DAPEDOGLOSSUS. 21 AMYZON COMMUNE ¼.

PLATE LIX.

Specimens from the Amyzon shales of South Park, Colorado, and from Osino, Nevada, natural size.

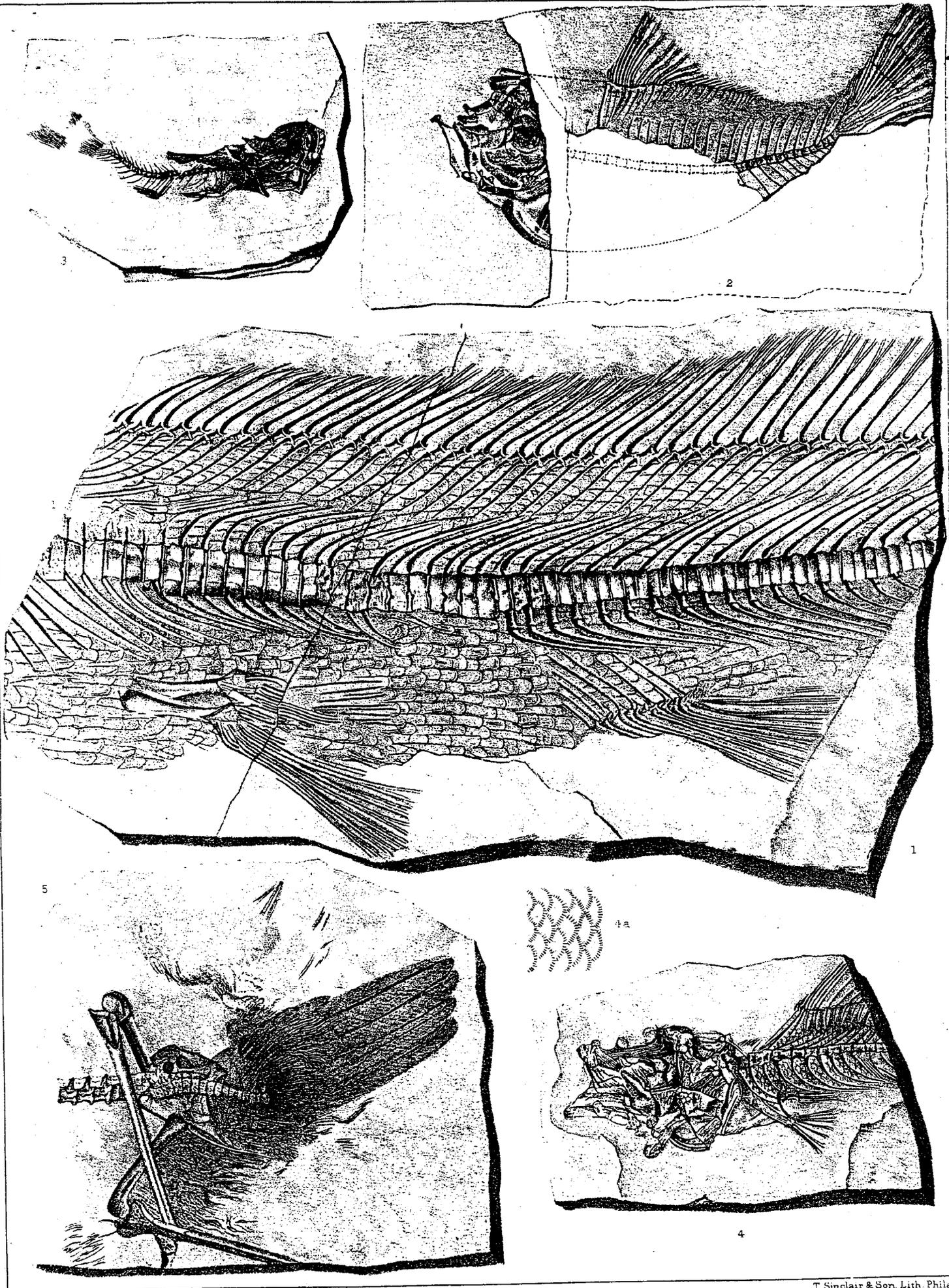
Fig. 1.—*Amia dictyocephala*. Left side. One of the types from Florissant, Colorado. Page 745.

Fig. 2.—*Amyzon mentale*. One of the types from Osino, Nevada. Page 749.

Fig. 2.—*Trichophanes hians*. Types from Osino, Nevada. Page 753.

Fig. 4.—*Trichophanes foliarum*. From Florissant, South Park, Colorado, type; 4a, scales enlarged.
Page 753.

Fig. 5.—*Charadrius sheppardianus*. From Florissant, Colorado. Discovered by Dr. Hambach. Page 755.

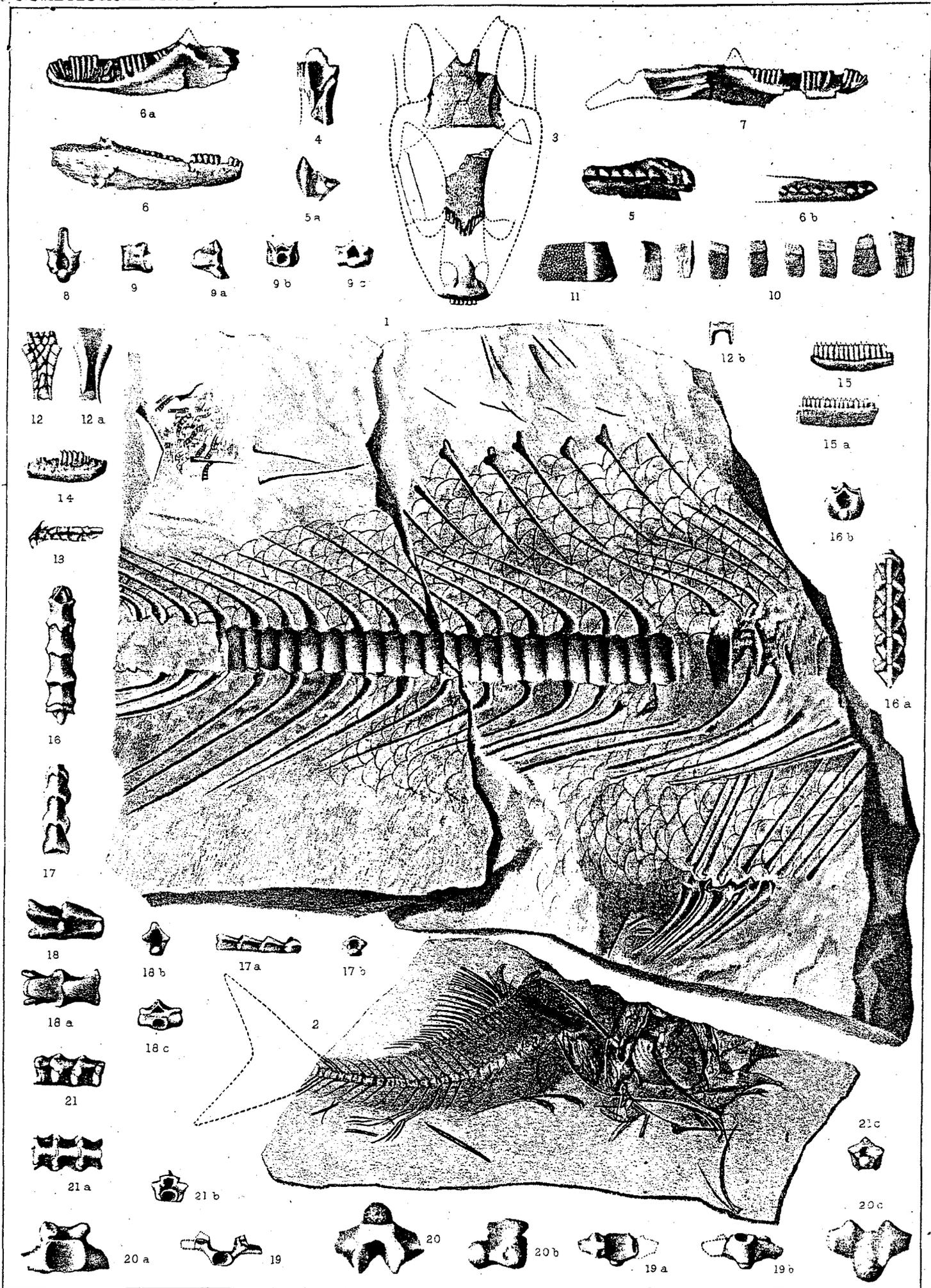


1. AMIA DICTYOCEPHALA. 2. AMYZON MENTALE. 3. TRICHOPHANES HIANS. 4. TRICHOPHANES FOLIARUM.

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PLATE LX.

- Fig. 1.—*Amia scutata*. Typical specimen, natural size; from the Amyzon shales of South Park, Colorado. Page 745.
- Fig. 2.—*Amyzon mentale*. Second specimen from the Amyzon shales, 20 miles north of Osino, Nevada; natural size. Page 749.
- Figs. 3-21.—Bones of *Lacertilia* and *Ophidia*, from the White River beds of Northeastern Colorado.
- Figs. 3-11.—*Peltosaurus granulosus*. Typical specimen, natural size, except figs. 5, 6, and 11, which are twice natural size. Page 773.
- Fig. 3.—Cranium restored in outline, showing superior faces of parietal, frontal, premaxillary, maxillary, and malar bones.
- Fig. 4.—Inferior side of frontal bone.
- Fig. 5.—Maxillary teeth, from below, twice natural size; *a*, end of the same.
- Fig. 6.—Right mandibular ramus, lacking the posterior third, inner view; *a*, internal view; *b*, superior view, showing edges of crowns of teeth of distal part of dentary bone, twice natural size.
- Fig. 7.—Left mandibular ramus, inner side.
- Fig. 8.—Anterior vertebra, from behind.
- Fig. 9.—Dorsal vertebra, side view; *a*, inferior, *b*, anterior, and *c*, posterior views.
- Figs. 10, 11.—Dermal scuta of the body; the smooth ones are seen from below.
- Figs. 12-14.—*Exostinus serratus*, twice natural size. Page 776.
- Fig. 12.—Frontal bone from above; *a*, from below, *b*, anterior view.
- Fig. 13.—Post-frontal bone, external face.
- Fig. 14.—Ramus of mandible with teeth, internal view.
- Fig. 15.—*Aciprion formosum*. Ramus of mandible, twice natural size, inner view; *a*, external side. Page 776.
- Fig. 16.—*Crematosaurus carinicolis*. Anterior five vertebrae, including axis, twice natural size, from above; *a*, from below; *b*, posterior view. Page 781.
- Fig. 17.—*Platyrrhachis coloradoensis* s. Type; vertebrae seen from above twice natural size; *a*, the left side; *b*, posterior view. Page 778.
- Fig. 18.—*Platyrrhachis rhambastes*. Dorsal vertebrae of two individuals, twice natural size; right side of one individual; *a*, inferior side of the same; *b*, posterior view of the same; *c*, anterior view of another. Page 779.
- Fig. 19.—*Platyrrhachis unipedalis*. Sacral vertebra, anterior view; *a*, superior view, the neural arch being absent; *b*, inferior view. Page 779.
- Fig. 20.—*Diacium sesquipedale*. Sacral vertebra, from above; the posterior part of the neural arch broken away; *a*, anterior; *b*, lateral, and *c*, inferior views. Page 777.
- Fig. 21.—*Aphelophis talpivorus*. Typical specimen; three dorsal vertebrae, left side; *a*, inferior side; *b*, anterior view; *c*, posterior view. Page 782.



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1. AMIA. 2. AMYZON. 3-11. PELTOSAURUS. 12-14. EXOSTINUS. 15. ACIPRION. 16. CREMASTOSAURUS.