As a rule, especially in plants like *L. syphilitica*, which are of simple habit, the flowers are visited by bees from the lowest one of the raceme upward, as has been observed by others to be the case with so many other plants. The humming-bird that I saw visiting *L. cardinalis* also acted in precisely the same way. As the lowest flowers are the oldest, and consequently the only ones in the pistillate stage of development, it is evident that they will usually be fertilized by pollen from a distinct plant, and after they are all fertilized, pollen is taken from flowers situated higher on the raceme for the fertilization of the older flowers of the next raceme visited. With the creeping *L. erinus* I have noticed that bees visit the flowers indifferently, alighting on almost any flower which protrudes from the tangle. But after once alighting they generally adhere to the branch on which this flower is situated, working upward upon it; though this is not invariably the case.

In many species, perhaps all, the style elongates sufficiently to cause the mature stigma to stand at a considerable distance without the anther-tube, thus making it still more certain that it will be brushed by an insect visiting the flower than is the case with the tip of the anthers, for a superabundance of pollen admits of an occasional failure to remove it, but it is imperatively necessary that each stigma be fertilized.

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A CONTRIBUTION TO THE ZOÖLOGY OF MONTANA.

BY E. D. COPE.

THE Territory of Montana, taken as a whole, is probably the most valuable tract of land which has not yet been placed under control of a State government, within the limits of the United States. As is well known, the diminished elevation of the Rocky mountains and adjacent plains, as well as the northward bend of the isothermal lines, indicate for Montana a milder climate than that of the Territory of Wyoming on the south, and that of Dakota on the east. Its agricultural wealth is greater than that of either of those Territories, and it is superior to both in the yield of its mines. Timber abounds on its numerous mountain ranges, and it is, par excellence, the range of the large game of North America.

My acquaintance with this region was chiefly obtained through

an expedition which I undertook in the summer and autumn of the year 1876. I left Franklin, Utah, by the Helena stage, which carries its passengers through parts of Idaho and Montana, reaching Helena in four days from the time of starting. The route first traverses the rolling country of Bear river, and then enters the sandy lava desert of Eastern Idaho. Passing this inhospitable region, we cross the main range of the Rocky mountains and enter Montana by the Red Rock valley, which is watered by one of the creeks which form the heads of the Missouri. Here commence the beauties of Montana scenery. The numerous parallel ranges of low mountains are capped by masses of lava, the remnants of an ancient outflow that once covered the country. The faces of this rock are vertical, often approaching columnar, and generally possess a serrate crest. The slopes below them, and the lower valleys, are beautifully green. Before reaching Helena a portion of the granite region is passed over. Here the scenery is of a different character. The more yielding material of the rock has given the hills more rounded forms, and huge masses of weathered boulders, piled in the most grotesque manner, are often seen. The timber is more abundant, and the hills abound in game, especially grouse (*Tetrao obscurus*, etc.). On their sides several species of *Sciuridæ* are numerous.

Continuing beyond Helena to the north-east, the Palæozoic region is reached. The stage route for Fort Benton passes through the Prickly Pear canyon, a narrow pass of a thousand feet in depth, between great walls of carboniferous rocks. After issuing from it and crossing a high mountain, the stage descends to the plains. Previous to visiting this region, I had not realized the fact that the same plains with which I had become familiar in Kansas and Colorado, extended west and north of the Missouri river, with all their peculiar scenery and products; the buffalo grass, the prairie dog and antelope, the yelping coyote, the owls, the prairie rattlesnake and the herds of bison. At Fort Shaw the Rocky range towers grandly on the western horizon, and on the east the Belt mountains rise abruptly in magnificent proportions from the level plain.

The road thence to Fort Benton is varied by ponds and "slews" whose proportions depend on the quantity of the rains. These are the homes of numerous Siredons, Speas and toads.

From Fort Benton eastward the Missouri flows between high

and often precipitous banks, and the elevated plain on the north side gives uninterrupted views of great beauty. To the north east the red granite masses of the Bear's Paw mountains obstruct the view, and to the south, mountains of various outlines form the horizon. These are the Belt, Judith and Snowy ranges, and they enclose, with the bend of the Missouri river, an extensive plain. From this plain rise several table-topped masses, evidently remnants of old strata protected by an outflow of lava.

At the mouth of the Judith river the special object of my exploration began to claim attention, viz: the investigation of the beds of the Judith River Lignite formation and the extraction of their fossils. The results of this work are given in the Bulletin of the U. S. Geological Survey of the Territories, F. V. Hayden in charge, Vol. III, No. 3, 1877. The exploration included the valleys of the Judith river, Dog creek and Two Calf creek, and the canyons of the south side of the Missouri as far east as Amell's creek, and the corresponding situations on the north side of the river on the return to Fort Benton. These streams carve deep canyons through the yielding lacustrine and marine strata which underlie the plains, which often present scenery of terrible desolation and grandeur. The bluffs of the Missouri reach the height of one thousand feet in many places, and in but few localities are passable by wagons. The labyrinths of their branch canyons are only passable by pack animals, and the high land can only be successfully reached by a most careful discrimination of the main "divides," or water-sheds, from the innumerable spurs which diverge from them.

The plains of this region are neutral ground between the Crow and Sioux Indians, who are ever at war; and they have not been regarded as a safe abode for white settlers. The only Americans in the region are the few wood-choppers on the Missouri bottoms, and the freight and other agents of the Missouri river steamers and shipping houses, who for a few months of every year are stationed at Cow island. The country is practically left to the game, which is here generally unmolested excepting by occasional hunting bands of Indians.

While geological and palæontological exploration was the primary object of the expedition, a few zoölogical notes were taken, which I here record.

Mammals.—One of the characteristic mammalia of Montana

is the *Haplocerus montanus*, or Rocky mountain goat-antelope. It is not rare, and is said to be easily domesticated. The most southern and eastern locality at which I heard of its occurrence is the Prickly Pear canyon.

The abundance of game on the plains south of the Missouri is well illustrated by the experience of a day on which I rode from my camp to some bad lands which lay at a distance of perhaps ten miles from it. In the course of the ride I passed at least a dozen antelopes at different points, and the usual population of prairie marmots and several coyotes. On reaching the summit of a hill I came suddenly on four fine buck *Cervus macrotis*, and soon after descried a few bison grazing at no great distance. Passing a stream I surprised three does of the *Cervus macrotis*, and afterwards came upon the rather fresh trail of elk. On my return from the bluffs in the afternoon I encountered four grizzly bears together. They displayed considerable curiosity, and for some time seemed undecided as to the proper course to pursue; they advanced towards me one step and retreated two, and so alternately moving forward and backward they reached the edge of the rising ground upon which they stood; they then quickly disappeared behind it, and when they next came into view, were in full retreat some distance away.

Reptiles and Batrachians.—There was nothing noteworthy observed respecting reptiles. Not a tortoise was seen, and the only abundant snake was the *Crotalus confluentus*. This rattlesnake grows to its largest size in the Upper Missouri region, and is abundant in localities of different characters. The next most common reptile is the *Phrynosoma douglassi*, and after it the *Heterodon simus*.

Much more of interest was observed in the department of *Batrachia*.

Rana pretiosa Bd. and Gird. I found this species quite common in the Prickly Pear canyon and valley, associated with perhaps another and smaller species, which I did not succeed in taking. This west coast form is apparently confined to the damper mountainous regions, as I never met with it in any other part of the Rocky mountains, and it disappeared as soon as we entered on the plains. I observed a *Eutænia* in the same localities, but no Phrynosomas. The *Rana pretiosa* has shorter legs than the *R. aurora*, which with some varieties, can only be regarded as a subspecies of *R. temporaria*, so far as I can see.

Rana halecina berlandieri.—This abundant species replaces the preceding on the plains, and is the characteristic, and indeed the only *Rana* of the limited batrachian fauna of that widely extended district. On leaving the mountains this species immediately appears, accompanied by *Phrynosoma douglassi*, *Crotalus confluentus*, *Heterodon simus*, etc. The form which inhabits the plains differs in color and superior size from that found in the tide-water swamps of the Atlantic coast, on which account I have retained for it the sub-specific name at the head of the paragraph.

Spea bombifrons Cope.—This species is characteristic of the northern parts of the Plains and Great Basin. It was especially common in the region north of the Missouri river and eastward of Fort Benton. Before my arrival there, rain had fallen, and the ruts of the wagon trails were filled with water. These ditches contained numerous examples of this species, together with *Chorophilus triseriatus*, *Bufo dipternus* and *Amblystoma mavortium*. Their metamorphosis was completed by that time (August 20th), although some of the specimens were small.

In Idaho, near latitude 43° 30′, is situated a body of water known as Market lake. Its extent is variable, for it is said to be dependent for its water supply on the overflows of the Snake river, which is a few miles distant to the eastward. An old channel leads from the river to the lake, giving probability to the statement. At the time of my passage through the region, the water was unusually high, for a portion of the stage road with parts of numerous telegraph poles, was submerged. The lake appeared to be about ten miles long by six in width. The country surrounding it is arid, and the sand which represents soil, rests on a basis of lava. The stage halted for a short time to enable me to examine the shore of the lake. I found it to be lined with a wind-row of grasshoppers (*Caloptenus spretus*) which had fallen into the water and been washed up, some living, others dead. Among them I found numerous large fat larvæ of *Spea bombifrons*, occupying small spaces which they had cleared, quite out of the reach of the water. Their limbs were nearly fully grown, while their tails had suffered no absorption, and their jaws were toothless and cartilaginous; some quite larval in form, others with wider gape. They were engaged in eating the grasshoppers, and I detected several specimens with the entire insects in their mouths. In some instances the grasshoppers' bodies were too

large and projected from their mouths. These precocious larvæ were evidently air-breathers, and hopped about, presenting a curious appearance as they dragged their large tails after them. I found some adult specimens of *Amblystoma mavortium* also, along the waters edge. These observations were made on the 11th of August, 1876.

Chorophilus triseriatus Wied.—This widely distributed species I obtained at Franklin, on the Utah-Idaho boundary, and subsequently found it very common in the ruts of the wagon trails on the plains east of Fort Benton. In the latter locality it was generally of a bright green color.

Bufo dipternus Cope, sp. nov.—This toad I found abundant on the plains north of the Missouri river east of Fort Benton, in the wagon ruts of rain-water, in company with *Spea bombifrons*, etc. It is of about the same size as the latter species, and resembles it in various ways; it doubtless has similar fossorial habits, as it is furnished with a tarsal shovel of the same proportions, and has in addition a second tarsal bone produced into a digging spur. The prefontal bones are thickened in the same way, although not to the same extent as in *Spea bombifrons*, a condition, no doubt, directly connected with the habit of pushing aside the earth while excavating burrows with the feet. It is easily distinguishable from the Spea, by the ordinary collector, by its large dorsal spots, which are much better defined than are the small ones of the *S. bombifrons*. I did not find the *Bufo dipternus* south of the Missouri river; there its place is occupied by a very distinct species.

This *Bufo* differs from the *B. lentiginosus* and all its sub-species in the presence of two well-developed fossorial tarsal spurs, and in the large size of the internal one. In this respect it need only be compared with the *B. compactilis* Wiegm., from South Texas and Mexico. It is distinctly related to the latter, but is separable from it as a distinct species on account of (1) its much smaller size, reaching only half the dimensions, (2) the smaller size and obscurity of the tympanic membrane, which is only one-third the diameter of the eye-slit, while in *B. compactilis* it is one-half the same diameter, and is well defined, (3) the larger and truncate internal tarsal spur, and (4) the coloration, which is quite distinct. The head in the adult *B. compactilis* is also distinctly shorter.

There are two faint straight supraorbital ridges, and a postorbital but no supratympanic ridge. The supraorbitals are united

by the enlargement of the posterior part of the prefontal bones, which forms quite a tuberosity in adults. These bones slope steeply, truncating the muzzle obliquely in profile to the nares; the latter then descends vertically to the lip border. The sides of the muzzle are flat. The length of the head to the line of the postorbital ridges is just one-fourth of the length to the extremity of the coccygeal style; it enters the same axis of the *B. compactilis* five and one-half times. The parotoid glands are wide ovals and are in contact with the postorbital ridges as in *B. compactilis*. The choanæ are rather smaller than the nares. The skin is roughened with small tubercles above and below, those of the superior surfaces being larger and more spaced. When the hinder leg is extended forwards, the end of the astragalus reaches the tympanic membrane. The posterior digits are shortly webbed at the base. Their extremities, like the spurs, are capped with brown horn, but these sheaths are readily lost in spirits, and with them some of the characters of the species.

In life the color of this species is ashen, marked with three pairs of large brown spots on the back. A similar spot crosses each eyelid, and there is a pair on the end of the muzzle. There are two or three large longitudinal spots on the sides which may unite into two bands, one above the other. The spots have blackish edges and paler centers with yellow or red tips on the tubercles; the ground is brighter round the spots. The limbs have similar large spots on their superior surfaces, and the palms and soles are yellowish. There are two large spots below the eye, and smaller spots on the tips in front. Below immaculate.

Length of head and body, m. .040; do. of head, .010; width of head behind rictus ovis, .016; length of fore limb, .020; do. of hind limb from vent, .048; do. of hind foot, .022.

This species is one of the handsomest of the nearctic species of the genus.

Bufo ? sp.—I have already alluded to this toad as representing the *B. dipternus* on the south side of the Missouri river on the plains of Northern Montana. I saw numerous specimens on Dog creek, but was unfortunately unable to preserve them on account of the want of spirits. The species is small and resembles the *Spea bombifrons* in its color much more nearly than does the *B. dipternus*, since it exhibits numerous small spots without margins. But it does not have the developed tarsal spurs of the *B. dipternus*, and resembles much more nearly the *B. lentiginosus*. I am under the impression that it should be considered a subspecies of that widely distributed toad.

Amblystoma mavortium Baird.—I have already mentioned finding this species in rain pools north of the Missouri, and on the

shore of Market lake, Idaho. Twelve miles northward of the latter is a much smaller body of clear water which is more permanent in its character, since I was told when there that it had not been dry since 1871. On the shore I found several specimens of the *Amblystoma mavortium* in various stages of transition from the larval condition. They mostly presented stumps of the branchial processes, with a greater or less degree of atrophy of the fimbriæ. These animals occupied holes the size and shape of their bodies excavated vertically in the sand, from which their heads protruded. They were so situated as to be overflowed by every slight change of level of the water, which also kept their holes full. This situation is especially adapted to a state of transition from a branchial to a pulmonary respiration.

This is the only species of salamander I observed in Montana. Its abundance in the central district of the nearctic region is now well known, and a full account of its numerous transitional and color forms will be found in my monograph of the genus *Amblystoma*, published in 1867.[1]

Fishes.—The food fishes at Fort Benton are the *Lucioperca americana*, the *Scaphirhynchops platyrhynchus* (sturgeon) and the *Lota maculosa* (ling). Of these the *Lucioperca* is easily the superior, but the sturgeon is not a bad fish. The "chub" of the river at that point is the *Pogonichthys communis*, which sometimes grows to a foot in length, and is the usual bait for hooks. *Hyodon tergisus* is common there also. In the mountain streams at the heads of the Missouri and its tributaries the trout and white-fish (*Coregonus williamsonii*), are the universally prized pan fishes. I heard that the grayling (*Thymallus montanus*) occurs occasionally with them, but did not see it myself. The following is a list of the species which I observed in the Missouri river and its tributaries. Of course it is a mere contribution to the subject, as I did not fish extensively at any point. The larger number of species were taken at the lower part of the course of Battle creek, which empties into the west side of the Missouri not far north of the mouth of the Moreau, Dakota. At the season of the year (October) when I visited it, the creek was reduced to a chain of pools, which occupied hollows in the clay shales of Cretaceous No. 4. The alkaline substances from these shales saturated the water, but this did not prove fatal to very numerous specimens of eight species of fishes.

[1] Proceedings Academy Natural Sciences, Philadelphia, p. 166.

ND = North Dakota

Percomorphi.—Lucioperca borea Richdn.—Abundant all along the river. The specimens agree very nearly with the description of *L. canadensis*, given by Jordan,[1] but I find six long pyloric cœca, two a little shorter than the others. The second dorsal rays number nineteen in three specimens, the last one split. Girard gives the number as twenty.

ND *Lota maculosa* Lesc.—Common; Battle creek.

ND *Nematognathi.—Ichthælurus punctatus* Raf.—Pools left by the river near Battle creek.

ND *Plectospondyli.—Semotilus corporalis* Mitch.—Battle creek.

Pogonichthys communis Gird.—Fort Benton, Judith river.

ND *Rhinichthys maxillosus* Cope.—Battle creek.

Phoxinus milnerianus Cope, sp. nov.—Form elongate; chin slightly beyond upper lip. Pharyngeal teeth 2.5–4.2. Scales in fifteen longitudinal rows between the dorsal and ventral fins. Diameter of orbit equal to length of muzzle, and entering length of head three and a-half times. The latter enters the length to the origin of the caudal fin four times. The greatest depth enters the same five and a-half times. The dorsal fin originates above a point behind the entire base of the ventral. Radii D. I. 8. A. I. 8. The mouth is rather large, the extremity of the maxillary bone extending nearly to the line of the pupil of the eye. The head is rather flat above and wide, the parietal width being about one-third the length between the last dorsal ray and the base of the caudal. The distance to which the lateral line extends is unknown because the scales of the posterior part of the body are lost.

Color brownish-olive above; below silvery. A black band, not well defined on the borders, extends from the end of the muzzle to the base of the caudal fin, where it terminates in a black spot. A reddish spot at the base of the anterior dorsal rays, muzzle dark. Length, m. 0.065.

This species differs from the *P. neogæus* Cope, in its slender form and small number of rows of scales. It is dedicated to my friend Jas. W. Milner, of the U. S. Fish Commission.

ND *Chrosomus* sp.—Small individuals from Battle creek.

ND *Hybognathus evansi* Girard.—This fish was very abundant at Battle creek. It has the slender suborbital bones of the *argyritis* group, with the small eye of the *nuchalis* group, and is a well marked species.

ND *Hyborhynchus nigellus* Cope.—From Battle creek; originally described from Colorado in the Report of Lieut. G. M. Wheeler.

[1] First Annual Report of the Ohio State Fish Comm., 1877, pp. 69–87.

I may here mention that the *Hyborhynchus siderius* Cope, is a *Hybognathus;* its enumeration under the former head being the result of some one's inadvertence. The *Rhinichthys maxillosus* of that report I believe now to be distinct from the species I called by that name, and I propose that it be termed *R. transmontanus*. It differs from the more eastern species in having the dorsal fin equidistant between the base of the caudal and the end of the muzzle, and in having the longitudinal series of scales below the lateral line more numerous (12–13) and equal to the number of scales above it. In *R. maxillosus*, from Battle creek, they number $\frac{10\text{-}12}{7\text{-}9}$.

Isospondyli.—Hyodon tergisus Les.—Judith river and pools of the Missouri near Battle creek.

Coregonus williamsonii Gird.—Heads of the tributaries of the Upper Missouri.

Ginglymodi.—Lepidosteus productus Cope,[1] and *L. otarius* Cope.—I found both these species in pools left by the Missouri river near Battle creek, maintaining their characters exactly. They differ in both proportions and color. The *L. productus* is lead colored above and white below, the colors gradually commingling on the sides. There are no spots on the sides nor at the base of the tail, and there are three spots on the caudal fin. In *L. otarius* of the same small size, the darker lead color of the back is abruptly separated from the white of the belly by a row of dark spots, and there is a black spot at the base of the caudal fin. The spots on the latter are large and more numerous. ND

The specimens I obtained of both species are young. One of the *L. productus*, of eight and one-half inches in length, exhibits the persistent caudal *chorda dorsalis* with dermal margin, which has been observed by Prof. Wilder. It is nearly absorbed in a rather larger example.

Chondrostei.—Scaphirhynchops platyrhynchus Raf.—Abundant in the Missouri. An individual taken at Fort Benton weighed forty-seven pounds. I secured its head.

[1] Proceed. Academy, Philadelphia, 1865, p. 86.