

The collection is mainly from the Amazon and the LaPlata, and their tributaries. The waters of the Amazon, the LaPlata, and the Orinoco are united through their tributaries, and so far as their fish fauna is concerned form but one river system. The fish fauna of any one of these rivers is therefore very similar to that of the others. The only genus which was considered peculiar to the LaPlata fauna is *Cochliodon*. This genus I find represented in the collection by four specimens from Marajo, near the mouth of the Amazon; so there is now no genus from the LaPlata which is not also found in the Amazon's system. These specimens, which belong to the species *Cochliodon cochliodon*, are of further interest inasmuch as the genus and species has heretofore been known only from the types in the Museum of Vienna.

From the Rio San Francisco there are but four specimens, all of a species common to the mouths of the east coast rivers of Brazil. The rivers of southeast Brazil, which Dr. Eigenmann has shown to have a fish fauna distinct from that of the Amazon to the north and the LaPlata to the south, are not represented in the collection. Lake Titicaca is represented by a single specimen, *Pygidium rivulatum*. This species, with *Rhamdia quelen*, are the only cat fishes found in Lake Titicaca. Both of these are alpine forms characteristic of the mountain streams of the Peruvian Andes.

HOW THE COLLEGES COULD AID THE PUBLIC SCHOOLS IN TEACHING BIOLOGICAL SUBJECTS. By W. W. NORMAN.

THE ICHTHYOLOGIC FEATURES OF THE BLACK HILLS REGION.* By B. W. EVERMANN.

[ABSTRACT.]

Last September I was directed by the U. S. Commissioner of Fish and Fisheries to make certain investigations in Iowa, Nebraska, South Dakota and Wyoming for the purpose of determining the advisability of establishing one or more fish-cultural stations in those states, and if it should be found desirable to establish stations in that region, to determine the most suitable places for their location.

Investigations of this kind require a more or less careful study of the

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physical, chemical and biological features of the streams and lakes of the region under consideration, for these in their various phases are the forces or conditions which constitute the *fish-environment*, and which determine the abundance, condition and distribution of the fish life of each hydrographic basin.

While carrying on these investigations, I spent the greater part of the month of October in and about the Black Hills, and it is to some of the biologic characteristics of that region that I desire to call your attention.

The Black Hills are, as you are aware, an isolated mountain group lying in southwestern South Dakota and eastern Wyoming. These Hills lie wholly within the basin of the Cheyenne River, which is formed by the union of the North and South Forks. The North Fork of the Cheyenne, or the Belle Fourche, as it is usually called, has its rise west of the Hills, flows around them on the north side, and to the eastward joins the South Fork which also rises west of the Hills and sweeps around them to the southward in a wide curve very much like that of the Belle Fourche on the north.

The immediate drainage of the Hills is by means of numerous smaller streams, nearly all of which flow eastward in approximately parallel courses to one or the other of the two Forks, those flowing into the Belle Fourche doing so from the right bank, while those reaching the South Fork flow into it from the left bank. During our stay in this region we made collections of fishes in the following streams: Middle, Sand, Red-water, Crow, Chicken, Spearfish, Whitewood, Beaver, Rapid, Elk, Fall, Warm, Cold, Minnekahta, and Cottonwood creeks, the Belle Fourche and the South Fork of the Cheyenne, and in Montana and Cox's lakes, nearly all of which are well supplied with certain species of fishes. The study of these collections has opened up a number of interesting questions in geographic distribution.

The fish fauna of that portion of the Missouri system lying in and about the Black Hills is peculiarly restricted in its character. The fifteen species contained in this collection,—and no other species has ever been reported from any definite locality of this region,—represent but four families, viz.: two catfishes, four suckers, eight minnows, and one member of the codfish family. Eight of the fifteen species belong to one family, the *Cyprinidae*. Not a single species of spiny-rayed fish has been found in the streams about the Hills, and it is not likely that any will be found there. Many of the streams in or near the Hills would apparently furn-

ish congenial homes for sunfishes, bass, and even several species of darters. That these are not there must be due to the nature of the lower courses of the streams draining the hills, and that of the Cheyenne, to which they are all tributary. The Cheyenne is ordinarily a shallow stream whose waters are always more or less alkaline and filled with solid matter in suspension from the extremely easily eroded country through which it flows. The lower courses of the streams flowing from the Hills are through the same Cretaceous beds and partake of the same character. Only those species with which the struggle has become most severe will be driven to seek protection and food in the muddy, alkaline streams, and they alone would eventually find their way into the purer, clearer waters above. This, of course, means the soft-rayed, non-rapacious fishes, the suckers and minnows and other mud-loving forms.

The spiny-rayed species are aggressive, extending their attacks to all weaker forms about them, while the soft-rayed species are defensive, and seek protection in retreat. A spiny rayed fish has no occasion to ascend into the muddy, alkaline and uncongenial portions of these streams; the only thing which would cause him to do so would be a quest for food, but he finds it easier and more agreeable to get food of sufficient quantity and quality where he is. Not so with the soft-rayed fish; he must not only search for suitable food, but he must also see that his enemy, the spiny-rayed fish, does not catch him. The attacks of his enemies were probably the first cause impelling him to take refuge in the turbid water. Finding suitable and sufficient food in this new environment, and total relief from the persecutions of his old enemies, he finds the struggle for existence easy, the surroundings in time become bearable and perhaps agreeable, he moves about at will through all parts of the muddy stream and even into the headwaters where, still finding an abundant food supply and none of his old enemies, he is content to make his home.

Before mining began in the Hills in 1875 and 1876, nearly every stream possessed all the natural conditions necessary to make it an excellent trout stream. The waters were clear and cold, not subject to contamination from any source, and suitable food, such as insects and insect larvae, and the smaller crustacea and mollusca, was undoubtedly found then, as now, in abundance. With the exception of a few streams which are now ruined by mining operations, the creeks of this region are yet excellent for trout.

The explanation for their absence is practically the same as that which

accounts for the absence of spiny-rayed fishes. Land barriers have evidently proved competent to prevent trout getting in from the headwaters of the trout streams to the westward, and the mud and alkali which they encountered in the lower portion of the Yellowstone, the Missouri and the Big Cheyenne have as certainly proved an impassable barrier from that direction. Among the many regions of the United States which possess the necessary natural conditions for trout, the Black Hills district is the only one of any considerable area, if we except portions of the Yellowstone National Park, in which one or more species of *Salmonidae* are not or have not been indigenous. The absence of trout and all other species of fish from the various lakes and streams of the Yellowstone National Park (*e. g.* Lewis and Shoshone lakes, Gibbon, Firehole and Little Firehole rivers, and Indian, Glen, Nez Percé and Sentinel creeks) is undoubtedly accounted for by the presence of impassable falls where these waters leave the great rhyolite sheet which covers the Park, as shown by the investigations made by Dr. Jordan in 1889. The presence of trout in Yellowstone Lake and tributary streams, notwithstanding the fact that the outlet of Yellowstone lake (Yellowstone River) has two enormous falls which wholly prevent the ascent of fish, is quite evidently due to the most interesting and curious fact that there is a continuous waterway furnishing easy passage for trout from the upper tributaries of Snake River, by way of Two-Ocean Pass, into the upper Yellowstone River. That Yellowstone Lake could have been, and almost certainly was, stocked in this way from the Columbia basin, was demonstrated by the investigations which I made during my visit to Two-Ocean Pass in August, 1891.

The presence of trout in the upper tributaries of the Colorado, Rio Grande, Arkansas, and Platte, whose lower courses are, in some cases at least, not unlike those of the Cheyenne and Missouri, is a matter whose explanation is not without some difficulties. The relationships of the various species or sub-species of *Salmo* found in these different basins are very close and indicate a common origin at no remote date. Whether they are all descended from a form which came up from the Pacific coast or one from the Atlantic cannot be certainly known, though the bulk of the evidence points to the former view. But whatever may have been the fact, it is certain that the headwaters of the Columbia, Colorado, Rio Grande, Arkansas, and Platte have been connected in some way at some time or other, thus permitting the trout to spread into these various basins. That there are no trout in the Cheyenne basin would seem to indicate that

the streams of this system became separated and differentiated as a distinct drainage system, earlier than did those of the Platte, Arkansas, Rio Grande, Colorado, or Columbia, or else that they are streams of more recent origin and have never been connected at any time with any of the streams containing trout. Such a history as this for the Cheyenne, together with the shallow, muddy, alkaline character of its lower portion, seems to be a reasonable explanation of the absence of trout from the Black Hills.*

The effect of the peculiar alkali water of the Cheyenne and the lower course of the streams flowing from the Black Hills has been to reduce the fishes to a nearly uniform pale, faded or bleached appearance. Except those found above the alkali water, they are almost wholly without pigment cells of any kind. Perhaps the most extreme case of bleaching is that of the flat-headed minnow, *Platygobio gracilis*, which, of all American fishes, seems to be the one most perfectly adapted to these alkali streams.

The following is a list of the species of fishes obtained in the Black Hills and vicinity:

SILURIDÆ, OR CATFISHES.

1. *Noturus flavus* Rafinesque. Yellow Cat. South Fork of Cheyenne River at Cheyenne Falls, and Belle Fourche River at Belle Fourche.
2. *Ictalurus punctatus* (Raf.) Channel Cat. Middle Creek at Belle Fourche.

CATOSTOMIDÆ, OR SUCKERS.

3. *Carpiodes carpio* (Raf.) Carp Sucker. Found by us only in the Belle Fourche.
4. *Pantosteus jordani* Evermann. This species recently described by me as new (Bull. U. S. Fish Com., XII., Art. 2, 51-56, January 27, 1893,) was found by us in most of the streams of the Black Hills, viz: White-wood, Spearfish, Crow, Rapid and Hat creeks, and in the Belle Fourche. For full description, see the Bulletin mentioned above.
5. *Catostomus teres sucklii* Girard. Common Western Sucker. Found in Middle, Crow, Chicken, Rapid, Cottonwood and Hat creeks, and in the Belle Fourche.
6. *Moxostoma macrolepidotum duquesnii* (Le Sueur.) The Belle Fourche and South Fork of the Cheyenne, and in Redwater Creek.

*In his paper on "The North American Species of Salmon and Trout," printed in the U. S. Fish Commission Report for 1872-1873, Dr. Suckley, in giving the habitat of *Salmo lewisi* (*S. mykiss*), credits it to the "Black Hills, Nebraska, Dr. Hayden." I have been unable to verify this reference, and I believe it to be an error.

CYPRINIDÆ, OR MINNOWS.

7. *Hybognathus nuchalis placita* Grd. Western Silvery Minnow. Cottonwood, Hat, and Middle creeks, and South Fork of Cheyenne and Belle Fourche rivers.

8. *Pimephales promelas* Raf. Black-headed Minnow. Middle, Rapid, Cottonwood, and Hat creeks.

9. *Notropis deliciosus* (Grd.) Middle, Rapid, Cottonwood, and Hat creeks, and Belle Fourche River.

10. *Rhinichthys dulcis* (Grd.) Western Dace. Whitewood, Chicken, Crow, Rapid, Cottonwood, and Hat Creeks, Cook's Pond, near Spearfish, and Fall River.

11. *Couesius dissimilis* (Grd.) Found only in Rapid Creek.

12. *Platygobio gracilis* (Rich.) Flat-headed Minnow. Middle, Cottonwood, and Hat creeks, and Belle Fourche and South Fork of Cheyenne rivers, in all of which it is abundant.

13. *Semotilus atromaculatus* (Mitch.) Chub. Found only in Chicken, Crow, and Rapid Creeks. These are the most western localities from which this fish has been reported.

14. *Leuciscus neogivus* (Cope.) Found by us only in Cox's Lake and Chicken Creek, near Gammon's ranch, S. D.

GADIDÆ, OR COD-FISHES.

15. *Lota lota maculosa* (Le Sueur.) One specimen obtained at Cheyenne Falls. This is the only fresh water representative of the codfish family.

These fifteen species are, so far as known, the only fishes found native to the Black Hills. It is the intention to continue the investigations in that region during a portion of the coming summer, when it is expected that the exact limits in the range of at least some of these species may be made out. It is especially desirable to determine in what streams the spiny-rayed fishes make their nearest approach to this region.

THE PTARMIGAN OF THE ALEUTIAN ISLANDS. By B. W. EVERMANN.

[ABSTRACT.]

It was my good fortune to spend the six months from March to September, 1892, on board the U. S. Fish Commission steamer *Albatross*, which was engaged during that time investigating the habits, abundance and distribution of the fur-seal in the North Pacific and Bering sea. While

carrying on these investigations we touched at a number of places on the mainland of Alaska, and while cruising along the Aleutian chain of islands we visited most of those which are inhabited.

While the study of the birds of these regions was only an incidental part of my work, nevertheless I had opportunity to make considerable collections at Alexandrovsk and Saldovoi in Cook's Inlet, at Nuchek in Prince William Sound, on Kadiak Island, Unalaska, Amaknak, Atka and Attu islands, also upon Bering Island of the Commander group. Among these is a series of ptarmigan that is of much interest.

The species represented are the following: Willow Ptarmigan (*Lagopus lagopus*) and Rock Ptarmigan (*L. rupestris*) from Kadiak Island, Nelson's Ptarmigan (*L. rupestris nelsoni*) from Amaknak and Unalaska islands, Turner's Ptarmigan (*L. rupestris atkensis*) from Atka Island, and an undescribed species from the island of Attu, the most westerly of the Aleutian chain.

The two species from Kadiak Island were collected April 13 and 14, and are interesting as showing the plumage at that season. The Willow Ptarmigan ranges near the bases of the mountains and among the sparse willow growth of the lower portions of the island. At the time of our visit the snow had melted from considerable areas frequented by this species, while higher up the mountains, where we found the Rock Ptarmigan, and where there is little or no woody vegetation, the snow covering everything completely.

The principle of adaptation to environment was clearly illustrated by these two species. The one whose range was in the region still covered entirely with snow had not yet begun to change from winter to summer plumage, not one of the sixty odd specimens collected showing a single brown feather; the plumage of every one was a solid white. Not so, however, with the Willow Ptarmigan. Their plumage had already begun to change gradually with the slowly melting snow, and in most cases the head and neck had almost completely changed to the summer brown, while brown feathers were scattered here and there through the rest of the plumage.

It is easy to see that it is greatly to the advantage of each of these species to change from winter to summer plumage synchronously with the melting snows; too rapid or premature change as well as change too long delayed would defeat the object of protective coloration.

Specimens of Nelson's Ptarmigan were obtained May 19 and 20, and

others in June. Those obtained in May had changed considerably toward the summer dress, while those taken in June were in complete breeding plumage. On May 24 I spent the day on Atka Island, and secured a dozen good specimens of Turner's Ptarmigan. They were usually found low down, either in the lowest heather or among the tall dead grass of the lowest hills. They were always seen in pairs, and were evidently mated. When flushed the male utters a coarse, guttural note, not distinguishable by me from that of Nelson's. Most of their crops were empty, but some were filled with leaves of *Empetrum nigrum*. While the higher parts of the island were still covered with snow, the portions where we found the ptarmigan were almost wholly free of snow, and these birds were, as might be expected, in almost complete summer plumage.

The various species of ptarmigan are, as you know, non-migratory, in this respect resembling our native quail of Indiana; and the individuals found upon any particular island are, of course, practically limited to that one island. That ptarmigan are found upon several islands of the Aleutian chain is due either to the fact that the different islands were at one time connected, thus permitting the ptarmigan to spread over the entire area, or else that individual birds now and then found their way to other islands by being carried across by strong winds. Individuals thus carried to a new island remained there, of course, and, adapting themselves to the new conditions, became well established. In time, the new conditions, differing however slightly from those upon the island from which they came, reacted upon these birds and modified them more or less, until finally they became sufficiently differentiated to be easily distinguished from the ptarmigan of any other island. That differentiation of this character does take place is a well known fact to every student of insular faunas, and the ptarmigan of the Alaskan islands afford excellent illustrations of this important principle. The investigations made by Dr. Stejneger and Prof. Ridgway, some years ago, showed that the ptarmigan of Unalaska Island, of Atka Island, and of Bering Island must be regarded as three distinct species, or sub-species.

Unalaska is about 500 miles from Kadiak; Atka is nearly 400 miles further west; Attu is 500 miles west of Atka, and about 300 miles south-east of Nikolski on Bering Island. It will thus be seen that the island of Attu is quite as much isolated as are the others named, and I was therefore very anxious to secure specimens of ptarmigan from that island

if possible. That ptarmigan were to be found upon Attu Island I knew from the report of Mr. L. M. Turner, who visited the island in 1880-81, but who appears not to have collected any specimens.

The *Albatross* anchored in Chichagof harbor, Attu Island, on the evening of May 28, and I spent the next day on shore climbing over the snowy mountain slopes in search of the ptarmigan; and the search was rewarded by our securing five fine specimens, four males and one female. A comparison of these with the specimens which I had from Unalaska and Atka indicated that there are some well marked differences, and that the Attu Ptarmigan is worthy of at least sub-specific rank. Upon returning to Washington I turned the specimens over to the U. S. National Museum, where they have been examined by Doctors Ridgway, Stejneger, and Merriam, all of whom pronounce it a new and well-marked variety.

LOCAL VARIATIONS. By C. H. EIGENMANN.

[ABSTRACT.]

A detailed comparison of about 400 specimens of *Leuciscus* from the Columbia basin and the Fraser basin showed that each locality has a variety which in the aggregate was different from the varieties of every other locality. The fin rays were found to decrease with the altitude, and in a general way it was noticed that the variation between the specimens of the same species also decreased with the altitude. These facts were demonstrated by diagrams.

MODERN GEOGRAPHICAL DISTRIBUTION OF INSECTS IN INDIANA. By F. M. WEBSTER.

He who studies geographical distribution is, at the very beginning, brought to understand that the area of any one state, or, indeed, any single country, is far too limited in which to work out his problem, as in the majority of cases the influences which make the presence of a species possible lie, largely, outside the boundaries of such state. The entomology of Indiana is only a fragment of the world's entomology and must be studied in connection with its closely related factors. You will therefore, I hope, pardon me for beginning my subject at a long distance from home and with elements seeming at first to have little to do with Indiana insects.