later down terracing, the Catskill encountered a rock-ridge near its mouth and developed behind it an interesting meander-curve at about the hundred-foot contour in West Catskill, left as an elevated oxbow.

The entire problem deserves more extended field work.

George H. Chadwick

Canton, N. Y.,
June 3, 1910

On the Stickleback of Lake Superior

In 1850 Louis Agassiz[1] described a stickleback from Lake Superior which he called *Gasterosteus pygmæus.* The species was founded on three specimens, one less than eleven sixteenths, the other two less than one quarter of an inch long. The description given of these covers somewhat over a page. Most of it, however, would apply equally well to any form of the genus *Eucalia,* and there are only the following characters which seem of value as a basis for differentiation: the small size (Agassiz seems to have considered his largest specimen as representing the approximate maximum for the species); the relation of length to depth (eleven sixteenths of an inch, or less, to one eighth or one seventh of an inch); the dorsal fin formula (VI.–7 [?]); and the anal fin formula (I.–6). The supposed species is not discussed by Jordan in the paper in which he first fully describes the genus *Eucalia,* although the name is mentioned.[2] Eigenmann, in his review of the North American Gasterosteidæ,[3] includes it as a variety of *Eucalia inconstans;* and in this form it is taken over into Jordan and Evermann's "Fishes of North and Middle America."[4] This last work has taken over bodily Eigenmann's notes on the form, which notes are, however, inaccurate in ascribing to *pygmæa* a deeper body than to *inconstans.* I can discover no such character in Agassiz's original description. Supposing his largest specimen to have been only ten sixteenths of an inch long, and its depth to have been one seventh of an inch (the most favorable figures to make for great relative depth of body), the ratio will still be about four and one third. This would appear to give a rather more slender body than in typical *inconstans,* but in reality it lies well within the range of variation of *inconstans* as collected from almost any locality.

In the course of making a collection of Wisconsin fishes the State Geological and Natural History Survey had occasion last summer to send a collecting party under the leadership of Mr. H. H. T. Jackson to the Superior shore. Mr. Jackson was instructed to keep a special lookout for sticklebacks in those waters. As a result I have before me various lots of sticklebacks collected from the following places within the Lake Superior Basin: Mamie Lake (Vilas County); Montreal River and Lake La Vine at Hurley (Iron County); Siskiwit River, Siskiwit Bay, and Lost Creek Slough at Cornucopia, Flag River at Washburn, and Pike's Creek at Bayfield (all in Bayfield County).

Agassiz's specimens were taken at Michipicotin, on the northeastern shore of Lake Superior, undoubtedly either in the lake itself or very near it. There is no reason to suppose that any form existing there would not be found in other tributaries of the lake. Such close restriction would be unique among fishes of waters not landlocked. And more especially must this force itself upon us when we consider that *Eucalia inconstans* ranges from Saskatchewan to Ohio, and *Pygosteus pungitius* from France to Alaska, with only a slightly modified form in Greenland.

We feel justified therefore in believing that if *Eucalia inconstans pygmæa* exists, specimens of it would occur among our collections. A careful examination of all our specimens from Lake Superior discloses nothing that is not typical *inconstans.* But an examination of the few characters given for *pygmæa* shows that these in themselves have no value. Let us examine them separately.

First, Size:—This is easily disposed of. Any one who has had considerable experience in field work among our common fishes knows

[1] "Lake Superior," p. 314; Plate IV., Fig. 1.
[2] *Proc. Ac. Nat. Sci., Phila.,* 1877, p. 65.
[3] *Proc. Ac. Nat. Sci., Phila.,* 1886, p. 233.
[4] Bulletin 47, U. S. Nat. Museum, Vol. I., p. 744.

that the average size of any lot of one species of fish is very largely affected by the character of the water from which the lot was obtained. What the particular factors in any body of water are that affect this size is practically unknown. A very interesting case of this kind is found, however, in the common yellow perch of our lakes here at Madison. Lake Mendota, the largest lake, contains more perch per unit of area than any other body of water I have ever examined. But they are all small. Lake Monona, a smaller and somewhat shallower body of water, but freely connected to Mendota, which flows into it, contains a very much smaller number of this species, but they will average twice as large in size. The explanation, so it seems to me, is fairly clear: Lake Mendota (for reasons now unknown, although a greater relative plankton content probably plays a part), is more favorable for the hatching of perch spawn and the adequate nourishment of the young perch, as well as for their protection, or freedom from enemies. The absence of *Stizostedion* may be a factor here. As a consequence a relatively large proportion of the eggs laid develop to a stage where the perch need larger organisms for food. This very abundance of young perch brings about a struggle for the food supply, a struggle which results not so much in the extinction of the weaker individuals, but in a reduction of the amount of food obtained by each individual and hence a reduction in the rate of growth. Such a state of semi-starvation probably has little or no effect on the fecundity of the individuals concerned, for as we now know, the essential reproductive organs are about the last parts of the body to be affected by starvation.[5]

In Lake Monona, on the other hand, we may suppose the conditions for the development of perch eggs, and for the proper nourishment of young perch and their immunity from enemies to be much less favorable. Hence a much smaller number, as compared with the number of eggs laid, would reach the stage when larger food is taken. The much smaller number struggling for the supply of this larger food, would allow each individual a much larger share, and hence a much more rapid rate of growth, which would of course finally result in a much larger average size. That great differences in size among individuals of the same age may be produced thus has been well shown in star fishes, where the disproportion is sometimes startlingly great.[6] That such great differences may be possible demands great resistance on part of the animals against partial starvation, and this we know to exist in fishes as in most other poikilothermous vertebrates.

Similar observations among fishes, more particularly carnivorous fishes, can be made by any one. We believe that in the majority of cases a lake yielding regularly large individuals of a species (large-mouthed black bass for instance) will not yield the species in great numbers, while one yielding many individuals will rarely yield any above average size. This is corroborated in a general way in our collections of Gasterosteidæ from Wisconsin, and is very apparent indeed to any one actually collecting them. The character of size, therefore, can be set aside as of no value whatsoever.

The relation of body depth to total length has already been disposed of. To reach some conclusion concerning the dorsal and anal fin formulæ, I selected an individual of approximately the size of Agassiz's largest, eleven sixteenths of an inch. I measured to the *base* of the tail in order to give his description the benefit of the doubt. Even so, it must be admitted that it is a very small specimen to work with. By means of a binocular magnifying sixty-five diameters, it is comparatively simple to erect the dorsal and anal fins, and count the presence of ten soft rays in each. But Agassiz had no binocular, nor had he the better preserved specimens which result from killing in formalin. Trying to examine this specimen by the ordinary microscope immediately shows how difficult it would have been thus to determine the right number of soft

[5] Stoppenbrink, *Zeitschr. wiss. Zool.*, Bd., 79, p. 496; Schultz, *Archiv f. Entw. Mechanik*, Bd. 18, p. 555.

[6] Mead, *Am. Naturalist*, Vol. 34, p. 17.

rays, and how easy to overlook the smaller ones. Couple with this the uncertainties expressed by Agassiz himself, and the fact that he had only one workable specimen, and I think we are fully justified in concluding that the supposed differences do not exist. It would be in a measure rather remarkable if they did.

An examination of all our Superior specimens of *Eucalia* fails to disclose, as mentioned before, anything whatsoever to distinguish them, or any of them, from *Eucalia inconstans*. Until better evidence is produced of its existence, therefore, we believe that *Eucalia inconstans pygmæa* Agassiz should be dropped from our list of North American fishes.

George Wagner
Wisconsin Geological and
Natural History Survey,
May 1, 1910

THE GEOLOGICAL SOCIETY OF AMERICA ELEVENTH ANNUAL MEETING OF THE CORDILLERAN SECTION

The Cordilleran section of the Geological Society of America held its eleventh annual meeting at South Hall, University of California, Berkeley, March 25–26, 1910. As officers for the ensuing year were elected A. C. Lawson, chairman; G. D. Louderback, secretary, and H. F. Bain, councilor.

The following papers were presented and discussed:

The Limestone Plains of the Interior of Bahia: J. C. Branner, Stanford University, Cal.

Limestones, probably of Jurassic age, cover many thousands of square miles in the interior of Brazil, especially in the states of Bahia and Minas Geraes. In many parts of the same region valley floors are covered by recent limestone deposits spread out in horizontal sheets. These later limestones appear to be derived from the older ones by processes now in operation in the same region in modified form.

Geologic Work of Ants in Tropical Countries: J. C. Branner, Stanford University, Cal.

Work of considerable geologic importance is done in most tropical countries by certain ants and by what are popularly called white ants. The white ants are not ants at all, but belong to the Isoptera. The present paper gives the results of observations upon the abundance and habits of these insects, and the amount of earth moved by them in excavating their underground galleries.

Tables for the Determination of Crystal Classes: W. S. Tangier Smith, Reno, Nev.

This paper presents two different keys for the determination of crystals belonging to the thirty-two crystal classes, according to their morphology. One of these tables makes use of a center of symmetry as the basis for its main divisions, while in the other the center of symmetry is not considered. It is intended that in practical use one table may serve as a check upon the other. In the second table the classes are grouped in accordance with the classification recently proposed by Schwartz, while the class names are given according to both Krause and Dana.

The Occurrence of the Halogen Salts of Silver at Tonopah, Nev.: J. A. Burgess, Tonopah, Nev., and A. S. Eakle, Berkeley, Cal.

The occurrence was described of the chlorides, iodides, bromides of silver at Tonopah, and descriptions given of these minerals and associated minerals.

A New Development at the Mouth of the Mississippi: E. W. Hilgard, Berkeley, Cal.

This refers to the uprising of a serious obstacle to navigation outside of the Eads Jetties in the south pass, which has been made the mean outlet of the Mississippi and of navigation, on account of its being the only one of the Mississippi mouths showing no mud-lump activity. Professor Hilgard predicted, however, in 1869 that when the main current of the river was directed into the pass, such activity would begin within twenty to thirty years, as has now happened.

Contribution to the Geology of Eastern Oregon: E. L. Ickes, Berkeley, Cal.

A statement of the general stratigraphy and structural features of eastern Oregon with a more detailed discussion of certain formations and structures specially studied during a recent field trip in the east central part of the state.

California Earthquakes—A Synthetic Study of the Recorded Shocks: H. O. Wood, Berkeley, Cal.

A correlation of recorded shocks with the known faults of the region and especially with those suspected to show recent activity.

Secondary Pseudostratification in Santa Barbara County, Cal.: George D. Louderback, Berkeley, Cal.

There has developed in Tertiary friable massive