dene Weise. Jedesmal ist aber die Drehung bzw. ein Verflechten von Fasern die Ursache für die spiralige Anordnung der Fibrillen. So überraschend es auf den ersten Blick auch erscheint, daß eine ausgebildete, funktionsfähige Muskelfaser mit homogenen Fibrillen in eine andre, spiraliggestreifte mit heterogenen Fibrillen und vor allem mit ganz andrer physiologischer Funktion umgewandelt wird, so wird man, nachdem elf junge Najaden zur Untersuchung herangezogen sind, an der Richtigkeit wohl nicht mehr zweifeln können. Allerdings sind auf diesem Gebiete noch viele verwandte Fragen, besonders physiologischer Natur, zu beantworten. So möchte ich hier nur daran erinnern, daß die Glochidien und auch die jungen Najaden ihre Schalen sehr rasch schließen können, obgleich sie nur längsgestreifte Muskeln mit homogenen Fibrillen besitzen, die sich von denen des ausgewachsenen Tieres morphologisch gar nicht unterscheiden. Hier ist der Spekulation Tür und Tor geöffnet, so lange wir noch nicht die Physiologie und die Innervierung der Muskeln bei den Glochidien und jungen Najaden kennen. Mögen vorstehende Zeilen dazu beitragen, auf diese interessanten und doch noch so dunklen Fragen einiges Licht zu werfen.

Zum Schluß möchte ich nicht versäumen, Herrn Geh. Rat Prof. Dr. Korschelt für die freundliche Überlassung eines Arbeitsplatzes und für sein reges Interesse an dieser Untersuchung meinen herzlichen Dank auszusprechen. Ebenso bin ich Herrn Dr. Harms sowie Herrn Dr. Herbers für die tatkräftige Unterstützung und für die freundliche Überlassung des Materials zu Dank verpflichtet.

7. Some Fossil Fish Scales.

By T. D. A. Cockerell.

(With 1 figure.)

eingeg. 28. August 1914.

In the Cretaceous rocks of Colorado, as in many other places, it is possible to find many isolated scales of Teleostean fishes. These remains have usually been put aside without any attempt at identification; but since we have paid special attention to the scales of living fishes [1], it has become evident that fossil scales, hitherto considered of small value, may indicate much concerning the character of otherwise unknown fish-faunæ.

With the experience gained from the study of recent fishes, we might well proceed to the description of the various scales found in the rocks; but before doing so, it is extremely desirable to determine the

[1] Observations on Fish Scales. Bulletin U. S. Bureau of Fisheries. XXXII. October 1913.

precise character of the squamation of the described fossil fishes, so far as that may be done. In this matter the published descriptions and figures are usually of small value, and it becomes necessary to study the actual specimens in Museums. This is of course a great undertaking, requiring many students; the present writer cannot hope to do much, but a few notes made at the U. S. National Museum are offered herewith.

Amyzon sp. (Catostomidæ.)

"From near Pikes Peak". The character of the rock shows that it is from the Miocene shales of Florissant, Colorado.

A large fish; depth near middle over 50 mm.; spread of tail fully 50 mm.; scales cover basal part of caudal fin.

Scales with strong apical radii, with quite coarse regular circuli between, these more or less angularly bent in middle line; no lateral radii; apparently a few basal radii, but these not clear.

A detached scale shows circuli going all round, the basal circuli fine; basal and apical radii, but no lateral ones. The apical number 8 or 9. These scales agree well in type with the living Catostomidæ. Especially such forms as *Moxostoma cervinum* Cope.

Leuciscus turneri Lucas. (Cyprinidæ.)

No. 4302a. Part of type lat. (Miocene, Nevada.) It is also labelled *Semotilus*. I count 9 dorsal fin-rays, and 10 anal.

Scales with about 10 or 12 fine close nearly parallel apical radii, and normal circuli; apical circuli not or hardly angled. The scales can be seen distinctly only on the caudal peduncle.

This will stand as *Richardsonius turneri* (Lucas). Some of the Japanese species which Jordan and Metz refer to *Richardsonius* have 10 anal rays. In the modern American species the number is usually less.

I take occasion to note that Jordan and Metz (Mem. Carnegie Museum, VI, p. 18) refer a Korean species of *Phoxinus* to the American genus *Hemitremia*, because, they say, I found the scales of East Asian *Phoxinus* to differ from those of the true (European) genus. As a matter of fact, I have never seen any East Asian *Phoxinus*, and my statements referred only to the European and American fishes referred to that genus.

Syllæmus latifrons Cope. (Crossognathidæ.)

No. 4979. Cretaceous. New Mexico?

Broad scales with fine normal circuli, not at all transverse (i. e. not as in Clupeidæ) apex of scale not seen, but base and sides certainly without radii; well marked growth-lines at intervals. The absence of basal radii distinguishes this at once from *Mugil* and *Liza*. In Hay's

Catalogue of Fossil Vertebrata of North America the genus is placed in Mugilidæ, but A. S. Woodward shows that it belongs to a different, extinct, family.

Asineops squamifrons Cope. (Asineopidæ.)

Eocene. Green River, Wyoming.

Scales cycloid, with about six wavy or crinkled circuli across apical marginal area, continuous at sides with the lateral circuli, but cutting the other circuli abruptly (see figure); middle apical circuli very strongly angularly bent, and more or less angles practically to nucleus;

circuli regular and rather coarse; apparently no radii, certainly no apical ones. In latinucleate (regenerated) scales the whole apical field has transverse crinkled circuli; but the other condition, as figured, is normal, and was clearly seen in very many scales.

The type of *A. pauciradiatus* Cope was examined, but the scales were not distinct; they looked as if they might be different.

The scales are totally different from those of the modern *Aphredoderus*, and Cope was evidently right in placing *Asineops* is a distinct family. The wavy apical circuli resemble those of Gerridæ, but the rest of the scale is wholly different.

Oligoplarchus squamipinnis Cope. (Percoidea.)

Tertiary. South Dakota.

About nine very strong basal radii; apical circuli coarse, right across scale, rounded, not angled; some fine longitudinal striæ at sides of apex may indicate remnants of a ctenoid area.

The scale agrees with those of the Centrarchidæ.

Plioplarchus septemspinosus Cope. (Percoidea.)

No. 4997. (Tertiary; Oregon.)

Subquadrate scale of the usual Percoid type; about 13 spreading fan-like basal radii; sides with very fine circuli of ordinary type; circuli over nuclear region coarser, forming flattened arches, transverse in middle; apical area of the typical acanthopterygian type, but could not see the marginal teeth. The type of *Plioplarchus* is a much smaller fish, with many scales scattered all around it. These show about ten basal radii, and long sharp apical teeth. The scales may be compared with

those of *Acerina*, but the living genus has the nucleus more apical. There is nothing in the scales, I belive, to indicate that the genus differs from the Percidæ.

Sparnodus ovalis Agassiz. (Sparidæ.)

Monte Bolca. (Eocene.) A. S. Woodward makes this a synonym of *S. macrophthalmus.*

Typical acanthopterygian scale; 9 or 10 very strong basal radii; sides with fine normal circuli; apical margin not visible, but there is a well defined ctenoid patch with parallel jointed elements as in *Box vulgaris.* We thus have proof that this specialised type of structure is at least as old as the Upper Eocene.

III. Personal-Notizen.

Nachruf.

Am 9. August starb in Kopenhagen im Alter von 64 Jahren **G. M. R. Levinsen,** Direktor der 2. Abteilung des Zoologischen Museums, bekannt durch seine Arbeiten über Bryozoen, Hydroiden, nordische Anneliden usw.

Druck von Breitkopf & Härtel in Leipzig.