of the *Nectria* were found to be abundant on them. Professor Sears writes that this form of canker is doing serious damage in some of the orchards of the Annapolis Valley.

Specimens of the diseased branches were sent to Dr. R. Hartig, Munich, Germany, for identification, who writes that the cankers are caused by the fungus *Nectria ditissima.*

So far as I know this fungus has not as yet been recorded as occurring on apple trees in America, and its appearance in our orchards is of great practical importance since it is a serious pest to European fruit growers.

W. PADDOCK.

EXPERIMENT STATION, GENEVA, N. Y.

ZOOLOGY AT THE AMERICAN ASSOCIATION.

THE following papers were presented before Section F during the recent meeting at New York:

Sketch of the History of Statistical Inquiry of Evolution: By C. B. DAVENPORT, University of Chicago. The paper will appear in full in SCIENCE.

The Variation of Synapta: By C. L. EDWARDS, Trinity College. In the absence of the author this paper was read by title.

Variation among Hydromedusæ: By CHARLES W. HARGITT, Syracuse, N. Y. To be published in SCIENCE.

Variations in Jaws of Neries limbata: By MARIAN HEFFERAN, University of Chicago. Presented by C. B. DAVENPORT.

A quantitative study of variation made upon the species *Neries limbata,* collected at Cold Spring Harbor during the summer of 1899, gave the following results:

The character chosen for investigation was the number of teeth on the exsertile jaws. These number from 6–14 on each of the two jaws and were distinguished both for the sake of convenience and for purposes of comparison into definite teeth, those which occupy the distal half of the jaw and which are clearly separated from each other, and the indefinite teeth at the base of the jaw which are covered by a transparent horny layer.

The typical condition of the total number of teeth of 400 specimens of *Neries limbata* of Cold Spring Harbor is a curve of type I. or type IV., with a slight skewness in a negative direction from the mode 10. In case of the calculation of the right total teeth a transition from a curve of type IV. to an equally serviceable one of type I. could be made by dropping one extreme individual out of 400. The teeth on the right jaw appear to be slightly more variable than those on the left. The least variation is shown by the indefinite teeth. The degree of correlation between the two jaws is, on the whole, rather high, 0.820. Correlation is closer between the indefinite than between the definite teeth. A negative correlation exists between the definite and indefinite of the same jaw, that is, a small number of definite teeth is associated with a large number of indefinite and *vice versa.* An inverse relation also exists between the number of definite teeth and the age of the animal, older animals presenting fewer definite teeth.

This result as well as those of observation of many specimens showing many irregularities in the teeth, point to the conclusion that a process of erosion of the extreme teeth forms a large factor in the variation of the definite and perhaps indirectly of the indefinite teeth. A difference in the number of teeth in respect to the age of the animal has rarely been recognized in description heretofore and would be naturally overlooked unless a large number of specimens was examined. Little value can thus be placed upon the statements made in regard to the number of teeth in a large number of species where only a few specimens were found.

Some Cases of Saltatory Variation: By C. H. EIGENMANN and ULYSSES COX, Indiana University.

1. A specimen of *Rana pipiens* 54 mm. long has the forearm and hand of the right side duplicated. This arm is carried in a sling formed of a loop of the skin of the breast 4 mm. wide. This is a pathological abnormality rather than a variation that leads to the mutation of species.

2. A specimen of *Ameiurus natalis* 120 mm. differs from normal specimens in the total absence of all traces of the ventral fins. This is a saltatory variation which if prepotent might give rise to a race of catfish without ventrals, which would be considered generically different from the parent stock. This specimen is of interest in connection with the next case.

3. A variation of great importance and no small interest is presented by nine specimens of *Ameiurus melas*. These were collected at random from among a large number in Mitchell's Cave, Kentucky. Each one possesses one or more supplemental nasal barbels. These might give rise to the supposition that they are the direct result of the cave life, but an examination of all the data makes it probable that we are dealing with a coincidence of a cave habitat and a prepotent saltatory variation that appears adaptive to a cave existence. The conclusions arrived at concerning these specimens are: (1) the variation is saltatory. (2) it is bilateral without reaching perfect bilateral correlation; (3) it is improbable that the variation arose independently in each of the specimens; (4) the variation probably arose in one of the ancestors of the specimens; (5) admitting (4) the saltatory variation arising in an ancestor was prepotent to a very high degree.

Variation and Correlation in the Tibial Spines of Melanoplus: By C. B. DAVENPORT, University of Chicago.

This paper, embracing work done in connection with Miss Ora H. Hubbard gives the constants and their probable errors of the distributions of frequencies of the spines of the inner and outer rows of spines on the right and left-hand tibiæ of *Melanoplus femur-rubrum* from Newport, Rhode Island. The correlations of the number of spines in the various rows was determined quantitatively and the interesting result obtained that there is a greater correlation between rows symmetrically placed with reference to the plane of symmetry of the whole animal than there is between rows so placed with reference to the plane of symmetry of the single leg. Finally the range of individual variation is greater than the range of variation of the modes of various species of the genus *Melanoplus;* consequently in the individual variation of the one species there is provided material for the various typical numbers of spines found in all species of the genus.

Variation in Io: By C. A. Adams. To be published in full.

On the Origin and Distribution of Leptinotarca decem-lineata Say, and the part that some of the Climatic Factors have played in their Dissemination: By W. L. TOWER, University of Chicago. To be published in SCIENCE.

A New Eyeless Isopod Crustacean from Mexico: By A. S. PACKARD, Brown University.

Some years ago I received through the kindness of Professor A. L. Herrera, of the City of Mexico, an isopod crustacean taken from a well at Monterey, Mexico. It appears to be a true *Conilera*, and may be named *Conilera stygia.*

It is totally eyeless, and adds another to the blind fauna of our caves and wells. Hitherto the genus has been represented by but a single species, inhabiting the British coasts. Compared with Bates and Westwood's figure of *C. cylindracea*, the body is longer, the antennæ much longer, reaching to the middle of the first thoracic segment, those of the second pair nearly to the middle of the seventh thoracic segment. Only the first three pairs of legs are short, with a very thick hand; the four hinder pairs of legs are long, slender. The two last divisions of the pleopods are unequal, the outer division very narrow, but a little more than half as long as the broad inner division or endopodite. Length of body 25 mm.; breadth 5 mm.

This form is like most if not all other blind or eyeless arthropods in having a longer body, antennæ, and legs in compensation for the loss of eyes.

A Contribution to the Fauna of the Caves of Texas: By C. H. Eigenmann, Indiana University.

In the early part of September, 1899, I visited San Marcos, Texas, to secure if possible some living specimens of the cave Salamander occasionally thrown out of the Artesian well of the United States Fish Commission. This well taps an underground stream about 190 feet from the surface. No specimens of the Salamander *Typhlomolge* came to the surface during my stay, but I received two living specimens from Superintendent J. L. Leary.

Besides the Salamander three species of Crustaceans had been secured from this well. These were described preliminarily by Mr. Benedict, *Proc. U. S. Nat. Mus.*, Vol. XVIII. One of these, *Palæmonetes antrorum*, is very abundant and many are thrown out from the well each day. The eyes of this species are degenerate far beyond those of the blind *Cambarus pelucidus* of the Mississippi valley caves. They will be described elsewhere. The second one *Ciralonides texensis* is not nearly so abundant as the first. During my stay of three days I secured several specimens. It can readily be seen in the receiving basin of the well when thrown out.

The third *Crangonyx flagellatus* is much rarer and no specimen was secured during my stay. Instead however a single specimen of a related species (*Crangonyx bowersii*) was secured.

These are all the species that can readily be seen with the naked eye, when swimming about the receiving basin. A screen of bolting cloth (No. 2) placed over the outlet for a short time secured a number of additional species, viz, the front half of a new species of *Cæsidotea*, two new species of *Copepoda*, a *Cypridopsis* and a Crustacean that defied identification and was later lost, as well as a flat worm. The evidence from the screening is that there is yet a rich subterranean fauna to be obtained from this well.

There is near the well a spring arising evidently from the same source by the side of which the well is insignificant in its yield of water. No blind creatures have been recorded from this spring, and the difficulty in straining its output is much greater than that of straining the well. Through the liberal policy of the Honorable G. M. Bowers and Dr. Hugh M. Smith, of the United States Fish Commission, a plankton net is now in use at the San Marcos well, and we may expect other additions to the fauna of the well and the underground stream it taps.

Near San Marcos are two small caves. Ezell's cave was formerly open to the public and provided with steps and other facilities for entrance. The opening leads into a pit about forty feet deep, with one side, that nearest the entrance, quite perpendicular, but with some projecting rocks. At the bottom of this pit and at the side furthest from the entrance a smaller opening led downward to the water, which was said to be about one hundred feet from the entrance. The Texas variety of small boy has found amusement in rolling rocks down the entrance thus smashing the steps and closing the former opening at the bottom of the first series of steps. It was necessary to take a side branch to reach the water. This side branch, for sufficient reasons, I did not take to its end, although my assistants managed to get through to the water without, however, securing any specimens. I was amply rewarded for not entering the deeper recesses by finding in the twilight of the entrance pit an abundant cave fauna.

Not far from this cave is Beaver cave. This is a winding, twisting channel of no great height or width. All the available time was devoted to securing specimens and the cave was not followed to the end. There is no water except in a pit dug in the cave.

Animals, though few in species, were surprisingly numerous in both these caves. The following species were secured in the well and caves:

1.	A flat worm sp.?—Artesian well.	
	Mollusca.	
2.	*Helicina orbiculata* Say.	Ezell's Cave.
3.	*Vitrea petrophila*, Bland, pale var.	
4.	*Bifidaria contracta* Say.	
5.	*Helicodiscus Eigenmanni* Pilsbry, n. sp.	
	Crustacea.	
6.	*Cypridopsis vidna obesa* Brady and Robertson.	Artesian well.
7.	*Cyclops cavernarum* n. sp.	
8.	*Cyclops Learii* n sp.	
9.	*Cæcidotæa smithii* n. sp.	
10.	*Ciralonides texensis* Benedict.	
11.	*Brackenridgia cavernarum* n. sp. and genus.	Ezell's Cave. Beaver Cave.
12.	*Crangonyx Bowersii* n. sp.	Artesian well.
13.	*Palæmonetes antrorum* Benedict.	
14.	*Larval crustacean*, unidentified.	
	Myriopoda.	
15.	sp.?—Ezell's Cave. Beaver Cave.	
	Arachnida.	
16.	*Theiridium Eigenmanni* Banks n. sp.	Ezell's Cave. Beaver Cave.
	Thysanura.	
17.	*Degeeria cavernarum* Pack.	Ezell's Cave. Beaver Cave.
18.	*Nicoletia texensis* n. sp.	
	Orthoptera.	
19.	*Ceutophilus palmeri* Scudder.	Ezell's Cave. Beaver Cave.
	Diptera.	
20.	*Larval Chironomus.*—Artesian well.	
	Vertebrata.	
21.	*Typhlomolge rathbuni* Stejneger.—Artesian well.	

Convergent Evolutions as illustrated by the Blind Lizard Rhineura: By C. H. EIGENMANN, Indiana University.

Living specimens of the blind lizard *Rhineura* show a great similarity in color, shape and method of progression to earthworms which they also resemble in habits. Living specimens were exhibited.

The Development of the Eyes in the Blind-fish Amblyopsis: By C. H. EIGENMANN, Indiana University.

The eye is perfectly normally outlined. A lens is normally developed but does not become located within the iris. It degenerates early, disappearing before the fish exceeds 10 mm. in length. The optic nerve is normally developed, and retains its connection with the eye and brain till maturity. It gradually becomes attenuated, and in the old a connection between the eye and brain cannot be traced. The vitreous body does not become developed to any extent. The secondary optic cup at all times remains a shallow depression. An outer reticular layer does not develop and cones are uncertain in their development.

The Eye of the Cave Salamander Typhlotriton: By C. H. EIGENMANN, Indiana University.

The eyelids are closing over the eyes. The eye is normally developed. The retina is normal in the young but with the metamorphosis or shortly thereafter the rods and cones disappear.

Some of the Internal Changes which accompany Ecdysis in Insects: By W. L. TOWER, University of Chicago.

The most important of the changes which precede ecdysis in insects is the development of the exuvial glands. These are unicellular hypodermal glands, usually pear-shaped, with the smaller end prolonged into a tube which opens through a pore beneath the cuticula. Sometime before ecdysis these glands begin to grow larger, and the nuclei have well developed membranes with clearly defined chromatin skeins. In the few days immediately preceding ecdysis the glands enlarge rapidly, owing to the secretion of an albuminous fluid within the cells, and the nuclei become amœboid, sometimes branching in fine dendritic processes among the globules of the exuvial fluid. The time for ecdysis having arrived the glands pour out their contents gradually until there is a thin layer of the exuvial fluid separating the old cuticula from the hypodermis. The hypodermis now rapidly secretes a new layer of cuticula, and thus the whole animal is covered with this fluid, which enables it to crawl out of its old shell with ease.

These exuvial glands occur on all parts of the body, but are most numerous on the pronotum. After ecdysis they become small and rounded, with densely staining nuclei.

The point of interest now is the secretion of the secondary layer of the cuticula, which forms the real strength of the insect's skeleton. During ecdysis and for a short time thereafter the only cuticula is an extremely thin layer which is easily bent or torn, but about thirty minutes later the deposit on the secondary layer begins and continues until near the middle of the instar. This layer is often ten times the thickness of the primary cuticula, and seems to be like a cellulose layer, giving in some cases a 'cellulose test.'

Sugar and Muscle Fatigue: By FREDERIC S. LEE, College of Physicians and Surgeons, New York.

The origin of muscular energy, whether from nitrogenous or non-nitrogenous substance, has been disputed. There has likewise been much discussion over the respective parts played by the two recognized causes of muscle fatigue, namely, the destruction of substance necessary for contraction and the poisoning of the muscle by so-called fatigue products. Recent experimental evidence both for and against the idea that sugar is an important source of bodily energy has been brought forward by others. The author, together with Mr. C. C. Harrold, has studied the problem by experiments on cats which had been put under the influence of the peculiar drug, phlorhizin. It is known that this drug removes the carbohydrates from the body. Fasting animals were put under the influence of the drug, were then killed, and the contractile power of the muscles, which continues normally for several hours after death was then tested. The muscles of well-phlorhizinized animals were found to have a contractile power much less than normal, and in this respect resembled muscles in a pronounced state of fatigue. That this result was due to the removal of carbohydrate from the muscles rather than to a mysterious specific action of the drug on the muscle protoplasm is rendered probable by the fact that if dextrose be given to an animal that is well under the influence of phlorhizin the fatiguing effect of the drug is counteracted and the contractile power of the muscles is restored. It seems to be a legitimate conclusion that normally sugar is a source of muscle energy and the destruction of it a cause of muscle fatigue.

The supposed connection between the oncoming of rigor mortis and the loss of carbohydrate is confirmed by these experiments. A well phlorhizinized animal may begin to go into rigor within five minutes after death, and the rigor is often complete within a half hour.

The Structure of the Poison Glands of Schilbeodes gyrinus: By HUGH DANIEL REED, Cornell University.

The poison gland is supposed to be in the axil of the pectoral fins. It is in reality just beneath the epidermis and almost entirely surrounds the spine. Both dorsal and pectoral spines have poison glands. The gland tissue is composed of large, coarsely-granular, doubly-nucleated cells. Each poison cell is surrounded by a layer of spindle-shaped epithelial cells. The clavate cells of the skin are identical in structure with the poison cells. They are wanting in those places which are entirely covered or protected by other organs. From their resemblance in structure to the poison cells and their distribution, it is probable that their function is one of protection. The poison cells are regenerated from the cells of the epidermis.

Before the poison can be effectual the cell membranes must be destroyed, for there is no duct leading from the gland to the exterior. The spine is entirely covered by epidermis which has to be punctured.

Development and Relations between the Intestinal Folds and Villi of Vertebrates: By W. A. HILTON, Cornell University.

Folds, villi and valvolæ conniventes are convolutions of the mucosa alone, other foldings involving the muscular coats not being considered. Folds and villi are homologous, villi being more specialized and occurring usually in otherwise highly specialized vertebrates. Several influences upon size and form of villi are easily recognized, such as the influence of food and size of the animal. By phylogenetic and ontogenetic study of a number of species it is found that there are at least two ways in which the villi are formed from folds. The more usual way being like that which takes place with the chick, that is, straight folds becoming more and more wavy until very zigzag folds are produced and villi formed from these by separations which take place at the tip of the fold angles downward.

Villi are present in the large intestines of most mammals sometime before birth, and occur also in the appendix vermiformis of man before birth, possibly showing the appendix of man to be an atrophied part of the cœcum.

Hystolysis of Muscle in the transforming Toad (Bufo lentiginosus): By LOUISE KATZ, Ithaca, N. Y.

It is shown in this paper that while the outward changes in transformation are exceedingly rapid, taking place in about three days, the internal changes are in process for a considerably longer period. The first sign of muscle change is a myotome near the base of the tail opposite the growing legs. Here a few fibers, often but a single one, occur on each side. Later, when the legs are about three-quarters grown, degenerating fibers are scattered all along the tail, but are most numerous at the tip.

Forms of degeneration; there are four quite well-marked types:

1. Mass degeneration, in which the whole fiber degenerates in one or more large masses.

2. Degeneration with transverse bands of degenerating substance, alternating with bands of normal muscle.

3. Breaking of the fibrillæ into smaller fragments, the so-called sarcolytes.

4. Transformation into transverse bands with intermediate gaps as if liquefaction had taken place.

In all the types the changes appear to be intrinsic in the muscle itself; homogeneous material is produced, reacting characteristically with the various stains and fixers, and disappearing by liquifaction *in situ*. Thus far I have found no evidence of fragmentation of the nuclei, nor marked increase in protoplasm as described by various investigators. In many fibers, however, showing no other signs of degeneration, the nuclei were no longer evenly distributed, but collected in a longitudinal row near one end. Fat occurs as a late product of degeneration. There is no evidence that phagocytes play any part in the degeneration process occurring in the muscle.

The Biogenetic Law from the Standpoint of Paleontology: By JAMES PERRIN SMITH, Stanford University, California.

This paper was a general discussion of the repetition of ancestral characters in the ontogeny of the individual; difficulties of interpreting and correlating stages of growth of the individual with ancestral genera with illustrations taken from the life history of fossil invertebrates and an exhibition of ontogenic series of fossil ammonites, and a discussion of the meaning of the stages of growth.

Reconsideration of the Evidence for a Commom cinosaur-avian stem in the Permian: By HENRY F. OSBORN, American Museum of Natural History, New York City.

This paper will be printed in the *American Naturalist*, August, 1900.

Relation of Dinosaurs to birds as discussed since 1864.

History of opinion.

Theory of descent from a common stem form, Huxley.

Descent from Iguanodontia, Baur.

Gradual reaction of opinion to the view expressed by Fürbringer in '88, that Dinosaurs and birds have descended from a common reptilian ancestor.

Review of all the osteological resemblances between birds and Dinosaurs. Grounds for a reconsideration of the problem.

(*a*) The clawed quadrupedal ancestry of birds.

(*b*) Structure of the Permian Proganosauria.

(*c*) Origin of the bipedal type.

(*d*) Probability that birds and Dinosaurs sprang from a common bipedal type in the Permian period constituting dinosaur-avian stem.

The Reptilian Origin of Mammals as illustrated in the Structure of the Occipital Condyles: By HENRY F. OSBORN, American Museum of Natural History, New York City.

Huxley's theory of the amphibian origin of mammals recently revised by Hubrecht and Kingsley.

Difficulties in the theory.

Theory of derivation of mammals from the *Anomodontia.*

Tripartite structure of the condyles in these reptiles.

Essential tripartite structure of the condyles in certain mammals.

Mammal condyle of amphibian and not of reptilian origin.

Structure, Relationship and Habits of the Eocene Creodont, Patriofelis: By HENRY F. OSBORN, American Museum of Natural History, New York City.

This paper will be printed in *Bulletin* of the American Museum Natural History.

Discovery of a complete skeleton of Patriofelis, Seeley by the American Museum Expedition.

Full description of this skeleton by Dr. J. L. Wortman with theory of aquatic habits of the life and of the probable relationship of the aquatic carnivora.

Re-study of the skeleton.

(*a*) Skull and dentition of feline type.

(*b*) Feet transitional between raccoon and feline type.

(*c*) Probable terrestrial habits of this type.

(*d*) Insufficient ground for theory of relationship of the *Pinnipedia.*

Phylogeny of the Rhinoceroses of Europe: By HENRY F. OSBORN, American Museum Natural History, New York City.

This paper will be printed in the *Bulletin* of the American Museum of Natural History.

Difficulties in a systematic arrangement of Rhinoceroses resulting from recent discoveries.

Necessity of phylogenetic classification.

Great antiquity of separate phyla.

Our ignorance of the stem form.

Revision of the family Rhinocerotidæ into seven subfamilies representing different phyla.

Theory of migration from Africa.

On the Inflection of the Angle of the Jaw in the Marsupialia and other Mammals: By B. ARTHUR BENSLEY, Columbia University, New York City. To be printed in SCIENCE.

On a Phylogeny of the Marsupialia: By B. ARTHUR BENSLEY, Columbia University, New York City. (Abstract withdrawn.)

On the Composition of the Monotreme Skull: By B. ARTHUR BENSLEY, Columbia University, New York City. (By title.)

Lymphosporidium truttæ, nov. gen. nov. sp. The Cause of a Recent Epidemic among Brook Trout: By GARY N. CALKINS, Columbia University, New York City.

In October, 1899, my attention was called to a disastrous epidemic among the brook trout (*Salvelinus fontinalis*) in a Long Island Hatchery. Investigation showed the cause of the trouble to be a new genus which I have placed provisionally with the *Serumsporidia* (L. Pfeffer) among the Sporozoa, a class of parasitic Protozoa.

The spores of the parasites accumulate in the lymph spaces of the fish and prevent normal nourishment of the tissues. This leads ultimately to ulcers of various shapes and sizes.

The spores give rise to 8 sporozoites or germs each of which develop into an adult amœboid individual about 25 mu. (.001 inch) in length. This penetrates the bundles of unstriped muscle cells of the digestive tract and becomes mature. At maturity a spore-forming cyst is developed in the lymph and the spores are carried throughout the entire animal.

The epidemic which lasted from May until December, 1899, killed off all the fish in the hatchery. The origin, preventive measures and remedies were not discovered.

The Primitive and Secondary Types of Vertebrate Embryos: By PROFESSOR CHARLES S. MINOT, Harvard Medical School, Boston, Mass.

This paper gives a comparison of the development in marsipo-branchs, ganoids, dipnoans and amphibians as representing the primitive type of vertebrate development. The Selachian, Teleost, Sauropsidan and mammalian types are regarded as secondary modifications. It also includes a comparative study of the form of the embryo in the Ichthyopside and Amniota.

A Partial Phylogeny of the Genus Cancer. By A. S. PACKARD, Brown University.

A comparison of the miocene tertiary species of cancer (*Cancer Proavitus* Pack.) with the two species now living in the waters of Vineyard Sound, brings out the interesting fact that the extinct species is the stem or ancestral form from which the recent species have apparently descended.

Cancer Proavitus presents characters in which it resembles *C. borealis* as well as *C. irroratus*. It resembles *C. borealis* in the higher, more pointed granulations on the postero-lateral margin of the carapace, and in the quite high and sharp spines on the ridges of the hand as well as the numerous setiferous spines and hairs; on the other hand it is similar to *C. irroratus* in the shape of the nine teeth on the antero-lateral margin of the carapace, and in the straight postero-lateral margin of the same. It is rounder, narrower, the carapace more convex, and the body in general more hairy than either of the existing species.

It thus seems most probable that the miocene species, being a more generalized, composite form, is the ancestor from which, either toward the end of the pliocene or the beginning of the quaternary period, the two living species sprang. *C. irroratus* has inherited the exact shape of the lateral teeth and the shape of the postero-lateral margin of *C. proavitus*, while *C. borealis* has retained the higher spine-like granulations or submuricate feature of the carapace and hand and the hairiness of the body.

On the whole the evidence that our two northeastern species have descended from a much more rounded, convex, and hairy miocene form living in the same geographical area seems to be well established.

It would be most interesting to compare this fossil species with very young individuals of our living species, but after inquiry I find that they are not in existence in our museums. It is to be hoped that specimens of the very young may be collected and compared with the fossil species. It is known that in cancer the body grows wider with age.

A Review of the Problem of Sex Cells in the Hydromedusæ: By CHARLES W. HARGITT, Syracuse University.

A former paper before this section (*Proc. A. A. A. S.*, 1889) set forth the view that for *Eudendrium ramosum* the ova originate in the endoderm. This was not passed without controversy. As a preliminary contribution it was not emphasized at that time. After some years the problem was again taken up in connection with related problems and four species of *Eudendridæ* examined, namely, *E. ramosum*, *E. racemosum*, *E. dispar*, and *E. tenue*.

As a result it may be said that while in *E. ramosum* and *E. tenue* the ova arise strictly in the endoderm, and never at any time find their way into the ectoderm, in the species *racemosum* and *dispar* these products are found abundantly in both tissues. However, it must not be overlooked that in every case the primitive ova are found in the endoderm, and only during the process of growth do they migrate into the ectoderm. In view of these facts it would seem to be a just inference that their origin is endodermal, though in these two species they may migrate into the ectoderm and complete development in that position.

Any glance at the literature will show a a strange confusion as to data. Weismann himself has contributed to this, due in part to confusion arising in methods of work, done in part upon optical sections rather than actual. Similar errors have doubtless been due to similar methods by earlier as well as later observers.

However, it seems that in Hydromedusæ there is a great variation in this matter. For whether the hydroid or medusa be the more primitive, or likewise as to the more primitive character of hydro- or scyphomedusa, there must have been a time when there was a transition from the one to the other. If therefore such transitions have arisen phylogenetically, is it not possible that among the more plastic genera such transition may continue at the present time?

In any case it would seem to be extremely rash to predicate any such character as a diagnostic and distinctive difference between the sub-classes Hydromedusæ and Scyhhomedusæ.

The Mosaic of the Single and Twin Cones in the Retina of Micropterus salmoides: By GEORGE D. SHAFER, Indiana University.

In the *American Naturalist* for February, 1900, Eigenmann and Shafer described the different patterns of twin and single cones found by them in the retina of several different species of fishes. No attempt was made by them to determine the modification of any of the patterns in different parts of the same eye of any species.

The present paper deals with the modification of the pattern in the large-mouthed black bass, *Micropterus salmoides*. The questions more particularly dealt with are:

I. Is the pattern of the twin and single cones the same over the entire retina?

II. What relation does the direction of the rows of cones which go to make up the pattern bear to the surface of the eye?

III. What is the difference between the number and size of the elements in the young and old fish?

Several series of tangential sections were cut from a band passing from the anterior edge of the cornea around the back of the eye to the posterior edge of the cornea; other series were secured from a band passing from the upper edge around the lower edge of the cornea.

I. The variation of the pattern.

The general variation in the twin and single cones in this species is that of Eigenmann and Shafer's pattern D. In this pattern the twin cones are so arranged that if the lines joining the centers of the components of a twin (*i. e.*, the axes) were continued they would form a square; a single cone is placed in the center of this square. The division lines separating the components of the twin cones thus point toward the single cone. That is, the division lines form right angles with the sides of the square. This ideal pattern for this species is most nearly approached over the anterior and posterior surfaces of the eye. As we go from the anterior and posterior edges of the cornea toward the wider parts of the eye, the pattern changes from a square to a rhombus. Its area at the same time increases until we approach the back of the eye itself, where the patterns are again smaller and closer together; even crowded.

Immediately at the upper and lower edges of the cornea the division lines separating the two parts of the twin cones instead of pointing toward the single cones are turned until they point almost directly toward each other. At these points, the square has varied to a rhombus of which the two obtuse angles are almost one hundred and eighty degrees. The single cone remains in the center of this modification of the square. As we go from the upper and lower edges of the cornea toward the back of the eye, the rhombus is quickly changed into a square again. In other words the double cones soon have their division lines turned again in the direction of the single cones. Except very near the cornea, the patterns in the band from the upper to the lower edges of the cornea are much more crowded than in other parts of the eye.

II. The relation of the pattern to the eye. A study of the modification of the pattern as described in the first section shows that such a modification is brought about on the surface of the eye if the axes of the twin cones lie on two series of circles. The center of one of these series of parallel circles lies approximately at the upper edge of the iris, the center of the other approximately at the lower edge. These two series of circles cut each other at right angles near the anterior and posterior edges of the iris and cut each other at more and more acute angles at the top and bottom of the iris. The extreme modification that would be brought about by the close adherence of the twins on these lines is relieved by the interpolations of additional double rows of single and twin cones.

III. The patterns in the young and old fish. A comparison of the eye of a young fish 60 mm. long which measured 3.8 mm. from cornea to optic nerve and 4.7 mm. longitudinally with the eye of a fish 335 mm. long measuring 10 and 13 mm. respectively along the lines measured in the smaller specimen shows (1) that no new elements are added during the growth of the eye; (2) the distance between the elements increases about in proportion to the increase in the surface of the eye. The ratio between the surfaces of the smaller and larger eye is about 1:0.144, the average ratio between the distance from center to center of two elements of the pattern in the small and large eye is 1:0.164; (3) on the average the ratio between the size of the elements in the small eye and large eye is 1:2.

CONCLUSIONS.

I. The pattern varies in shape from a square on the anterior and posterior edges of the eye to a rhombus on all other parts of the eye except where rows of cones have been interpolated; and it is largest at the middle of the anterior and posterior faces of the eye.

II. The cones are arranged in rows which correspond to circles formed on the surface of the eye by two sets of parallel planes. One set of these planes is perpendicular to an axis passing from the upper edge of cornea through the center of the eye to the back and the other set of planes is perpendicular to an axis passing in a similar manner from the lower edge of the cornea.

III. As the surface of the eye increases in size toward old age the area of the patterns increases in about the same proportion. No new elements are added.

Development of the Lungs in the Frogs, Rana Catesbiana, R. silvatica, and R. virescens: By MARGUERITE HEMPSTEAD, Meadville, Pa.

The principal features of the development of the lungs in the American frogs studied may be stated as follows:

1. The formation of the respiratory apparatus is similar to that in the toad, but differs from the latter in having the communication with the pharynx formed very early in larval life instead of at the end as in the toad.

2. The respiratory apparatus arises as a solid downgrowth from a solid portion of the pharynx, which is unlike the formation of the lungs in Bombinator as described by Goette, and unlike the description of the process in other European forms in all the accounts available for reference.

3. The lung rudiment is single and solid, and not a pair of hollow evaginations as described by Marshall.

Development of the Lungs in the Common Toad Bufo lentiginosus and in the Tree Toads (Hyla pickeringii and Hyla versicolor): By SIMON HENRY GAGE, Cornell University.

With the tree toads the pharynx becomes hollow before the external gills are absorbed, and the lungs become hollow and open into the pharynx before the external gills disappear.

In *Bufo* the lungs and pharynx very early become hollow, but the larynx remains solid and has no communication with the pharynx until the tail is almost wholly absorbed and the young toad is almost completely transformed. The connection of the lungs with the pharynx seems to be one of the last acts of metamorphosis. When the larynx opens into the pharynx it is lined with ciliated epithelium, apparently the epithelium is non-ciliated before the opening is established.

In the ciliation of the oral cavity and the pharynx of the toad (*Bufo*) the columnar ciliated epithelium spreads from the œsophagus into the pharynx and the mouth.

The Chronological Distribution of the Elasmobranchs: By O. P. HAY, American Museum Nat. History, New York City.

There is first presented a diagram which shows, by means of curves, the number of species of fossil elasmobranchs which are known to have existed during each of the geological periods.

There is also presented a table which contains lists of the genera of Elasmobranchs which occur in each of the geological periods.

The portion of geological time occupied by each of the families is discussed.

Some conclusions are drawn bearing on classification of the Elasmobranchs.

The Lower Temperature Limits of Incubation for the Egg of the Common Fowl: By Charles Lincoln Edwards, Trinity College.

Since the time of the Egyptians it has been known that warmth is the chief factor in incubation of eggs of birds. Modern investigators have established 35 degrees C. to 39 degrees C. as the normal temperature range. Rauber ('84) gave as the optimum 38 degrees and minimum 25 degrees. It is well known that cold, if not too intense or too prolonged, will slow development.

Dareste gives 28 degrees C. as the physiological zero for the hen's egg, below which, of course, there is no development.

Kaestner produced anomalies by interrupting the normal development through cooling the egg.

Warynski showed that yolk rises because of change in specific gravity and sticks to the vitelline membrane, thus producing arrest of development and consequent monsters.

Féré ('94) established the ratio of development at abnormal temperature to the stage at normal of 38 degrees, as follows:

Temperature:	34°	35°	36°	37°	38°	39°	40°	41°
Index of development:	0.65	0.80	0.72	?	1.00	1.06	1.25	1.51

In my experiments a Cyphers incubator together with a calibrated thermometer divided to one-fifths of a degree was used.

Incubation 1. In 12 eggs incubated at 30.75 degrees C. for 7 days, 19 hours, chicks reached an average of about one-half the normal development. Over half of this clutch of eggs developed hydropic vesicles in the blastoderm. These arise from enlarged blood islands in the mesoderm, in which the primitive corpuscles degenerate and the space becomes filled with lymph.

Incubation 2. In 6 eggs incubated at 29¼ degrees C. for 5 days, 18 hours, the ontogenetic stage was from the 16- to the 24-hour chick. The cephalic end of the neural groove was trifid in one variate. Lateral branches of primitive groove were developed posteriorly.

Incubation 3. In 12 eggs incubated at 28¼ degrees C. for 7 days the ontogenetic stage was from a central area of undifferentiated mesoderm to 27 hours.

Incubation 4. In 10 eggs incubated at 27 degrees C. for 6 days, with the exception of one uncertain anomaly, the greatest development was represented by a primitive streak 1.8 mm. long. Blastoderms vary from 4.5 mm. to 8 mm. in diameter.

Incubation 5. In 9 eggs incubated at 26 degrees C. for 7 days, 19 hours, showed a primitive streak 1.3 mm. long as the greatest development with the exception of one case with open neural folds 1 mm. long. Blastoderms vary from 4 mm. to 7 mm. long.

Incubation 6. In 8 eggs incubated at 25.5 degrees C. for 6 days there was a variation from no development to a primitive streak and groove 1.7 mm. long. Blastoderms vary from 5 mm. to 5.5 mm. in diameter.

Incubation 7. 11 eggs at 25.5 degrees C. for 7 days, 2 hours, 8 developed from a central area of mesoderm cells to a primitive streak 2 mm. long. Of the other three one showed open neural folds and rudimentary brain, one 22 mesodermic somites and one was a 3-day chick. The last three may have been previously incubated. Blastoderms vary from 4 to 11 mm. in diameter.

Incubation 8. Nine eggs at 24.5 degrees C. for 6 days, $1\frac{1}{2}$ hours gave one primitive streak 1.5 mm. long as the greatest development. Blastoderms vary from 4 mm. to 1 cm. in diameter.

Incubation 9. 11 eggs at 24 C. for 6 days, 19 hours. Blastoderms vary from 5.4 mm. to 7 mm. in diameter. With the exception of a degenerated 2-days chick only 4 of the 11 blastoderms showed a trace of the primitive streak.

The Fishes of Africa as Exponents of former Geographical Conditions: By THEODORE GILL, Smithsonian Institution.

The fishes of Africa represent two very different elements. One is composed of Asiatic types; the other of South American types. The latter indicate a former connection direct or mediate with South America; the latter are in conformity with the present association of the continents.

The Moringuid Eels and their Geographical Distribution: By THEODORE GILL and HUGH M. SMITH, Washington, D. C.

The Moringuid eels are remarkable for their very elongate body disproportionally elongated abdominal cavity, and remoteness of the heart from the branchial apparatus. The family had been supposed to be peculiar to the oriental seas, but a recent discovery has directed the attention of the authors to the American eels generally and it was recognized that 3 genera previously associated with Murænesocidae really belong to the Moringuidæ. *Stilbiscus* indeed is a synonym of the type genus, *Moringua*. A new species of the related genus *Apthalmichthys* has also been added to the American fauna.

The History of the Word Mammalia: By THEODORE GILL, Smithsonian Institution.

The word mammalia was first introduced by Linnæus, in 1758, as the expression of a concept first appreciated by him. It was formed in analogy with animal. Simple as the explanation is it has never been recognized.

C. H. EIGENMANN,
Secretary.

SCIENTIFIC BOOKS.

An Introduction to the Study of the Comparative Anatomy of Animals. By GILBERT C. BOURNE. Vol. I. London, George Bell & Sons; [New York, Macmillan]. 1900. 16mo. Pp. xvi + 269. Price, $1.10.

It is rather difficult to form an adequate estimate of a work from its first volume. It is not easy to get the author's perspective; and then there are so many things left in doubt which the remainder of the series may straighten out. The plan of Mr. Bourne's work is peculiar. It starts out with a general chapter which deals with fundamental morphological and physiological principles, and then takes up the frog, treating first of its anatomy and then of its histology. This last subject leads up to a consideration of the cell, and this is followed by a consideration of the early history of the frog. The remainder of the book is occupied by detailed accounts of several Protozoa, Hydra and Obelia. We are promised that the second volume will deal with the Cœlomate Metazoa.

A rather careful examination shows few errors, yet there are several points on which the student will need fuller information than the volume affords. Thus terms are used without explanation or definition, while here and there comparisons are made which will not be intelligible because the student has no information as to one of the subjects of comparison. While finding fault it might be well to ask why it is that many English writers persist in the use of the terms epiblast, mesoblast, and hypoblast. It is not easy to see how the work can be used in courses of comparative anatomy as usually given in America, except as a reference book for occasional use. Its wealth of detail concerning forms usually studied in the laboratory would be seized upon by many students as affording answers to the questions which they are asked and are expected to obtain from the animals themselves.