

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE  
OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION  
FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JUNE 12, 1908

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## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION F—ZOOLOGY

### THE AMERICAN SOCIETY OF ZOOLOGISTS

A JOINT session of the Central Branch of the American Society of Zoologists with Section F, Zoology, of the American Association for the Advancement of Science was held at the University of Chicago, December 30, 1907, to January 4, 1908. This was the sixth meeting of the Central Branch of the American Society of Zoologists, and the largest in its history. President S. A. Forbes, of the Central Branch, presided at all the sessions, as President E. B. Wilson, of Section F, was unable to be present.

The society met at 2:30 P.M., December 30, at which time E. B. Conklin, the retiring vice-president of Section F, delivered an address upon "The Mechanism of Heredity." The following are the titles and abstracts of papers presented at this meeting.

*On the Specific Gravity of the Constituent Parts of the Egg of Chaetopterus and the Effect of Centrifuging on the Polarity of the Egg:* FRANK R. LILLIE, University of Chicago.

As the result of experiments with centrifugal forces of graded powers, the author concluded that the protoplasm of the polarized ovocyte of *Chaetopterus* possesses both a polar and a concentric organization of its ground substance, which is the basis of the so-called "segregation pattern," or arrangement of granules ("sub-

stances'') within the egg, and which determines the axis of embryonic development. This organization of the ground substance is not substantially altered by centrifuging, though it may be temporarily distorted thereby.

These conclusions depend upon the following considerations and observations:

I. *Concentric Organization*.—If the ground substance be perfectly homogeneous, granules moving under the influence of centrifugal force will pass in straight lines centrally and distally, according to their respective specific gravities, and will not be held in any intermediate position. Aggregation of granules in definite configurations or intermediate positions after centrifuging are *prima facie* evidence of differences of resistance of the ground substance.

Such definite configurations are found in the egg of *Chaetopterus* after the action of low centrifugal powers with perfect constancy; and these together with the evidence derived from study of the normal structure enable us to infer the following concentric organization of the ground substance: (1) An ectoplasmic layer of considerable density, open at the animal pole; (2) an intermediate more fluid layer which is especially developed at the animal pole, where it comes to the surface; (3) a ring of greater density, enclosing (4) a large subcentral, more fluid mass. The last corresponds in position and approximately in size with the original location of the large germinal vesicle.

As a consequence of this organization of the ground substance, the small basophile granules within the central, more fluid area aggregate in the dense ring bounding it, when low centrifugal powers are used. This aggregation is situated towards the axis of the centrifuge, as the basophile granules are of low specific gravity, and is lunate in cross-section; it contrasts vividly

with the surrounding parts of the egg after staining in strong basic dyes, such as thionin. Higher powers of the centrifuge drive such granules through the dense ring into the "clear zone" which contains the basophile granules from other parts of the egg. The acidophile granules also show typical configurations. The central, more fluid mass is practically emptied of granules when low centrifugal powers are used, because those within it are driven into the dense ring bounding it and those without do not penetrate the dense ring to enter it.

II. *Polar Organization*.—The polarity of the ovum before and after centrifuging appears to be the same whether the karyokinetic spindle retains its original position or not. This is inferred from the fact that the polar axis of centrifuged eggs (as determined by the position of the polar bodies appearing subsequent to centrifuging, and the later development) bears no constant relation to the axis of stratification of granules produced by centrifuging. Therefore the position of the granules of the egg does not determine its polarity. The latter may, therefore, be either a persistent feature of the ground substance, or may be determined by whatever point on the surface the maturation spindle happens to reach if displaced by centrifuging. The latter proposition appears highly improbable because (1) the polarity of oocytes with intact germinal vesicle does not appear to be determined by the point on the surface to which the germinal vesicle may be thrown by centrifuging (limited number of observations of author); (2) the position of the maturation spindle displaced by centrifuging is constant, viz.: in the clear band, but the polar bodies are frequently formed outside this band; (3) in other animals no cases are known where the position of the nucleus has been shown to determine polarity, but,

on the contrary, the polarity of the ovum is known to determine the position assumed by the cleavage nuclei. Therefore, it is believed that in *Chaetopterus* the ground substance retains its polarity after centrifuging and that the place of formation of the polar bodies is thereby determined.

III. As to specific gravity of the cell contents, the so-called gray cap, which is specifically lightest, is made up of residual substance of the germinal vesicle and numerous small granules that are blackened by osmic acid and are soluble in xylol, hence presumably fat granules. The intermediate or clear band contains the majority of basophile granules; the distal hemisphere contains the acidophile granules, and of these, those originally contained in the ectoplasm appear to be heaviest.

*The Variability of Zygosporos in Spirogyra quadrata* (Hass.) formed by Scalariform and by Lateral Conjugation, and its bearing on the Theory of Amphimixis: L. B. WALTON, Kenyon College.

With the object in view of obtaining data bearing upon the purpose of *amphimixis*, and the causes tending to produce *variability*—problems which have long remained most elusive in everything except theory—a biometrical investigation in respect to the comparative variability and correlation in 400 zygosporos of *Spirogyra quadrata* (Hass.) formed by scalariform and by lateral conjugation was undertaken.

In the first instance (scalariform conjugation) we deal with the results of conjugation between remotely related cells belonging to different filaments. In the second instance (lateral conjugation) we deal with the results of conjugation between sister or adjacent cells of the same filament, a condition closely related to the

phenomena of parthenogenesis in other organisms. If the conjugation of germ cells from remotely related individuals tends to variability as Weismann and others would have us believe, conversely the union of closely related cells should afford a decreased variability, the minimum appearing in parthenogenetic forms.

The results show a condition directly contrary to this, the zygosporos of lateral conjugation being approximately 21 per cent. more variable in length and 31 per cent. more variable in diameter than those produced by scalariform conjugation. Consequently direct evidence is afforded in support of the theory of Hatschek (1887) that sex exists for the purpose of limiting and not for the purpose of increasing variability.

A comparison of constants, the general discussion, methods of measurements, as well as a review of the literature, particularly papers by Warren, Kellogg, Pearson, etc., will be given in the completed paper.

*A Contribution towards an Experimental Analysis of the Karyokinetic Figure:* F. R. LILLIE, University of Chicago.

The alternative hypotheses (1) that the poles of the karyokinetic figure (centrosomes) are centers of force which acts outwards and exerts its effect at a distance (centrosome theory) and (2) that the centrosomes are merely centers of insertion of the organic radii (mitome theory), may be tested experimentally. On the first hypothesis, spindles that move through the protoplasm would produce new asters in the form of radiating "chains of force" (Hartog); on the second hypothesis the moving spindle would drag the organic radii with it and produce considerable distortion of the karyokinetic figure. On the first hypothesis, not only the rays of the asters, but also the fibers of the spindle, must be interpreted as chains of force, and

the chromosomes as well as centrosomes may be centers of force. Therefore, in any movement of the spindle through the cytoplasm, it is conceivable that its material also is constantly changing. If, therefore, the karyokinetic figure were suddenly moved from protoplasm of one morphological character into protoplasm of another, comparison of the normal and experimental conditions of the karyokinetic figure would furnish evidence for deciding between the two hypotheses.

The unfertilized eggs of *Chaetopterus* enable us to make such a test. After they have remained in sea water fifteen to twenty minutes, each possesses a large karyokinetic figure fixed at the animal pole, and this figure remains at the mesophase for hours. If such eggs be centrifuged with relatively low powers (1,150 revolutions in 30 seconds to 1,750 revolutions in 45 seconds) not only may the karyokinetic figure be moved through the cytoplasm, or the latter caused to flow past the spindle, but new configurations arise in the cytoplasm, owing to central or peripheral displacement (with reference to the direction of the centrifugal force) of the granules suspended in the ground substance of the cytoplasm. The most important of these configurations for our purpose is a dense accumulation of the basophile granules a little central to the middle point of the egg. This is a new formation called suddenly into existence, within 30 to 45 seconds, and contrasting strongly with the remainder of either normal or centrifuged eggs.

If a pole of the spindle enter this basophile mass, the granules of the latter appear to be rearranged in radiating lines that can be interpreted only as chains of force. Apparently the original radiations of the pole in question are lost, or are reenforced. The rays of the aster in the basophile mass are actually more numerous

than in the karyokinetic figures of control eggs, as determined by counting.

Any part of the basophile mass that enters the spindle appears also to be rearranged in chains of force: one finds that the part of the spindle within the basophile mass usually stains correspondingly, and thus contrasts strongly with the part without, and this is probably due in the first place to infiltration of basophile granules; but the modified part of the spindle is also fibrous in its structure and the interfilar spaces are empty of granules, so that it would appear that the infiltrated granules are arranged in chains.

Such distortions as are found in either the rays of the aster or the fibers of the spindle are explicable on the chain of force hypothesis; because it has been shown by Hartog that chains of force consisting of iron dust suspended in glycerine or balsam will bear great distortion before rupturing; and this is due in the first place to the fact that the longer path of a distorted chain is more permeable than the relatively resistant medium in which the permeable chains of particles are embedded, and in the second place (to a certain extent) to the viscosity of the medium.

The mitome hypothesis appears inadequate to explain the results of the experiments, and may certainly be regarded as disproved if actual counts show a definite increase in the number of astral rays proceeding from the pole embedded in the basophile mass.

If the center of force hypothesis be accepted, the results show that the basophile granules are extremely permeable to the "mitokinetic force" (Hartog) and that the ground substance is highly impermeable. Acidophile granules are also impermeable; or at least they are not arranged in chains of force.

*The Pacific Scientific Institution:* WM. A. BRYAN, Honolulu, T. H.

The institution recently incorporated in Honolulu has as its immediate object the promotion of a thorough biological and ethnographical survey of the Pacific Islands. Its more inclusive object, however, as stated in its charter, is "to encourage in the broadest sense and most liberal manner investigation, research and discovery in the Pacific Ocean and to make application of knowledge thereof to the improvement of mankind."

It is the design of the incorporation to create an international cooperative research institution in Hawaii by the affiliation of institutions at home and abroad, that will provide in the center of the region to be studied, a modern institution with adequate funds and facilities to carry forward rapidly the work of discovery and exploration and to make the practical application of the new facts thus gathered to the scientific and economic betterment of the world.

An especial board of trustees has been named to receive in trust, funds and property with which to promote the objects of the institution. Substantial progress has already been made toward providing such important facilities as a biological station, botanical garden and an aviary or zoological garden, all of which, as organized, will form departments of the institution and be supplementary to the scientific equipment already existing in Honolulu.

The field explorations of the institution will be carried on by an especially equipped yacht provided with auxiliary power. This vessel will use Honolulu as a center, and from it proceed to visit the Pacific islands, group by group. Fifteen years is allowed for completing the field explorations.

An international council composed of distinguished scientists and scholars will select an honorary staff of leading specialists who will have advisory super-

vision over the work, assistants and publications in the especial departments into which the investigation will be divided.

The scope of the general inquiry and survey, the disposition of the material collected, as well as the publications of the institution have been worked out along lines of helpful cooperation with a view to the definite advancement of scientific work in the region to be treated. The whole undertaking has received much favorable indorsement from prominent scientists and educators as well as from philanthropists and men of affairs.

*The Biochemical Action of Copper Sulphate on Aquatic Microorganisms:*  
AMOS W. PETERS, University of Illinois.

The concentrations of  $\text{CuSO}_4$  required to kill protozoa instantly and to inactivate the normal enzymes of their protoplasm were compared. Protozoa—*Paramacium* and *Stentor*—were freed from debris, separated from other organisms, and washed free from the organic matter of their native culture liquid, by the use of a filter of fine silk bolting cloth upon a separatory funnel, followed by the use of a centrifuge. The concentrations required to kill instantly differed greatly according to conditions, the values found ranging from 12 to  $60 \times 10^{-8}$  gram molecular parts of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  per c.c. The presence of diastatic and various other enzymes in the cell-bodies of these protozoa was demonstrated with complete freedom from such inaccuracy as could arise from the presence of bacteria. The methods used and the results obtained in the preparation of these enzymes will be reported in a separate communication. The diastatic enzymes were tested, with all necessary controls for their action upon starch, and the results were measured by both the Fehling and the polarimetric methods. At the concentration of  $\text{CuSO}_4$  equal to that of the kill-

ing point of the same organisms which furnished the enzyme, diastatic ferments are nearly or completely inactivated and their activity increases as the concentration of  $\text{CuSO}_4$  diminishes. Whether the same correlation exists with other enzymes and whether the cell bodies absorb and concentrate the  $\text{CuSO}_4$  from dilute solution, is still under investigation.

*Minimal Size in Form-regulation:* C. M. CHILD, University of Chicago.

The minimal size of pieces capable of complete form-regulation in a given species is not a constant quantity, but varies according to the region of the body involved and in some species with age. It may also vary to a certain extent with the physiological condition of the individual.

In *Tubularia* and *Corymorpha*, for example, a much larger piece is necessary for the formation of a complete hydranth and stem in the distal region of the original stem than in the proximal region.

In *Planaria maculata* a piece from the middle region of the body must be much larger than one from the terminal regions to produce a complete animal.

Similar differences are found in various other species of coelenterates and turbellaria.

As regards age differences, the minimal size of pieces capable of producing a complete animal is relatively greater in newly hatched specimens of *Planaria simplicissima* than in adult animals, though as regards actual size the reverse is the case.

Evidently, then, minimal size in these species is not simply a matter of a certain number of cells or a certain constant amount of living material, but is dependent rather on the position and function of the parts in the original whole. We may probably go a step farther and assert that it is primarily dependent upon

the rapidity of physiological or functional changes with change of level in the whole. Where this change is relatively rapid a piece of given length is physiologically more nearly a complete system than a piece of the same length in a region or at an age where the change from level to level is less rapid.

These facts constitute strong evidence against the cell theory in its more special form, for the number of cells may differ very widely in minimal pieces from different regions. They point to correlation between parts as the essential feature in regulatory and probably also in normal development—at least in certain stages.

*Galvanotropism of Bacteria:* J. F. ABBOTT, Washington University.

It being ordinarily understood that bacteria do not respond to the influence of a galvanic stream too weak to kill them, it seemed important to determine whether this be really so; and second, to determine, if a tropic response be obtained, in how far this might be altered by change in environmental conditions.

Results of extended work on *B. termo* and *B. subtilis* demonstrated without any question that pure cultures of these bacteria gather under the influence of very weak currents at the cathode and follow repeated reversals of the poles.

Pure cultures grown in acid-modified and alkali-modified peptone-gelatin appeared to respond in most cases, though not in all, in opposite manner, alkali cultures gathering at the cathode and acid cultures at the anode.

These results seem to be in harmony with those of Greeley on paramecium and give color to the conception that the galvanotropic response may be due to, or directed by, the physico-chemical constitution of protoplasm.

Work along this line is being continued.

*Some Reactions of the Pomace Fly (Drosophila ampelophila) to External Stimuli:* FREDERIC W. CARPENTER, University of Illinois.

*Drosophila* is negatively thermotropic to high and low temperatures. In reacting on a horizontal surface to the temperature stimulus the insect usually describes a continuous curved line, and gives little evidence of random movements indicating "trial and error" behavior.

Experiments with light have shown that *Drosophila* is positively phototropic. If one eye is covered with an opaque cap, the insect, in spite of the unilateral stimulation, creeps in a fairly direct path toward the light, although often showing a tendency to deviate toward the side of the normal eye. Occasionally a fly will perform circus movements, but this behavior is exceptional.

A violent uncoordinated motor reaction or convulsive reflex may be produced by stimulating *Drosophila* either by a high temperature, or by a low temperature, or by intense light (at a temperature of 30° C.) or by such irritating chemical substances as ammonia or acetic acid.

*Behavior of Perichæta and Lumbricus toward Stimuli of Various Intensities:*

E. H. HARPER, Northwestern University.

Stimulation of the anterior end on one side gives reactions of five types corresponding to the strength of the stimulus. The weak negative reaction of type I. is the terminus likewise of the next two types owing to the gradual subsiding of the stimulus. The medium reaction of type II. is therefore two-phased, retraction of the head being only the first phase. The increased intensity of the first phase in type III. (strong reaction) determines the backward crawling, allowing the posterior end to take the lead. The extension of the same strong condition of contraction

over the posterior end in the very strong reaction of type IV. prevents backward crawling owing to the weaker adaptiveness to backward as compared with forward movements. Strong turning with forward movement is, therefore, the very strong type of reaction. Type V. is a convulsive reaction. Type III. shows three subtypes according to strength of stimulus. Subtype III. (b) introduces squirming of the anterior end; III. (c) includes a rolling reaction produced by contracting the longitudinal muscle bands in sequence, which follows the squirming and precedes the backward movement. This rolling reaction wipes off the stimulating substance with secreted mucus. As variants may be noted omission of backward crawling from III. (b) and (c). Trial and error is not recognized in this apparently determinate series of reactions, though, as others have noted, the movements of type I. may be random. Of course the same description may be applied to V.

*The Reaction of Amphibian Embryos to Tactile Stimuli:* G. E. COGHILL, Denison University.

With reference to the reaction to a tactile stimulus upon the region of the trigeminus or vagus, embryos of *Triton torosus* may be grouped into three classes: (1) Individuals which from the first and during a considerable period respond regularly or almost regularly with a heterolateral (away from the side touched) head movement. (2) Individuals which for a relatively short period are irregular in the direction of the head movement and then enter upon a long period of heterolateral reaction. (3) Individuals which are at first asymmetrical in response, then enter upon a short period of irregularity and finally upon a period of heterolateral reaction, or pass directly from asymmetry to the heterolateral type.

The heterolateral head movement is a unit in the "action system." This unit is predetermined regardless of any experience on the part of the individual. The first response to a touch on the tail bud is a head movement and as the whole trunk comes to be flexed the movement still begins in the head region and progresses caudad. The earliest conduction paths, then, of the lower part of the cord are longitudinal and afferent, and the two halves are physiologically distinct during this phase of development. Specimens that are asymmetrical for head stimulation are so for tail stimulation also.

*The Phylogenetic Differentiation of the Organs of Smell and Taste:* C. JUDSON HERRICK, The University of Chicago.

Physiologists have not yet succeeded in finding a well-defined criterion for the separation of these senses in terms of the character of the stimulus, nor can they be easily distinguished psychologically. Nevertheless, their nervous mechanisms are very different and these anatomical differences seem to have assumed practically their definite form in the very lowest vertebrates. In seeking for the explanation of this differentiation of two chemical senses in low aquatic vertebrates, attention is directed to the character of the motor responses as giving the key to the evolution of the very diverse reflex paths for smell and taste. The typical response to stimulation of the taste buds within the mouth is a visceral reaction (mastication, swallowing, etc.); that of olfactory stimuli is a somatic reaction, usually toward or away from the source of the stimulus. A quite different set of nervous pathways is involved in the latter case from that of the former. Assuming that smell and taste have evolved from a common type of undifferentiated chemical sense, this difference in mode of reaction to chemical stim-

uli within and without the mouth is adequate to call forth in the course of further evolution the structural differences which we find between these organs in higher vertebrates.

*The Mesencephalic Root of the Trigeminal in Reptiles and Mammals:* J. B. JOHNSTON, University of Minnesota.

This bundle of fibers has long been known in man and mammals and described as the descending or cerebral motor root of the trigeminal. The writer has described it in selachians, ganoids and anurans as a part of the sensory root. The same is now found to be true in reptiles (turtle, snake) and in mammals (mole, cat, white rat, pig embryo and human embryo of 15.5 mm.). In the adult mammals studied the bundle in question is made up of two parts. One part arises from the spinal trigeminal tract at about the level of the facial nerve, runs dorsalward through the substantia gelatinosa, turns cephalad between the gelatinosa and the vestibular centers, passes over the dorso-caudal surface of the motor nucleus of the trigeminal, and gains the internal face of the brachium conjunctivum near the fourth ventricle. Here it is joined by the second part, which comes up from the sensory trigeminal root among the trigeminal fibers to the cerebellum. The combined bundle has on its mesal and ventral side a column of large and small cells which is closely related to (merges with) the vestibular nuclei. The bundle and column of cells continue forward into the mesencephalon in the well-known manner.

In the human embryo studied (and pig embryos also) the relations of the sensory and motor roots at their connection with the brain are such that there seems no possibility of confusing the two. The bundle under consideration is made up in the same way as above described and is further

clearly separated from the motor root by the intervening lateral groove of the brain. This groove separates the dorsal and ventral halves of the brain wall (Flügelplatte and Grundplatte, His); the sensory root and the mesencephalic bundle are dorsal to this groove, the motor root ventral to it. The sensory and motor portions of the trigeminus are at this time widely separated. At the level of the exit of the fourth nerve the mesencephalic bundle holds a position between the central and peripheral limbs of the trochlearis which is characteristic for all vertebrates. Dorsal to the peripheral limb of the trochlearis, however, is to be seen in the human embryo a large bundle which runs from the tectum mesencephali into the cerebellum, the tr. tectocerebellaris which occupies this same position in lower vertebrates. Hence, the cutaneous sensory fibers are distributed through the whole length of the dorsal half of the brain wall as far forward as the superior colliculus. *The roof of the midbrain is still in part a primary cutaneous sensory center, even in man.* This gives the strongest morphological support to the account of the evolution of the cutaneous, auditory and visual primary and secondary reflex centers and the cerebellum out of a primitive longitudinal column or zone whose functions were at first simple cutaneous sensory.

*The Epibranchial Placodes of Ameiurus melas and nebulosus:* F. L. LANDACRE, Ohio State University.

The epibranchial placodes in *Ameiurus* arise just posterior to the dorsal portion of each gill slit and give rise to elements in the cranial ganglia quite distinct from those of the dorso-lateral placodes and of the neural crest.

The ectodermal area in which the placodes occur is indicated first by active mitosis and later by a process of prolifera-

tion which is almost complete; and the ganglion is almost detached from the ectoderm before it comes into contact with cells from the dorso-lateral placode and neural crest except in the case of the third division of the tenth nerve.

The placodal portions of the seventh, ninth and first two divisions of the tenth nerves have been followed to a late stage and give rise to the portions of these ganglia which furnish communis fibers to these nerves.

Whether the epibranchial ganglia furnish gustatory fibers only or general visceral fibers also has not yet been certainly determined, but the evidence is very strong that they give rise to special visceral or gustatory fibers only.

The direction of proliferation of the placodal cells is backward, and their first connection with the remaining portions of the cranial ganglia is by means of a delicate intermediate cell mass.

*Pinkus's Nerve in Amia and Lepidosteus:* CHAS. BROOKOVER, The University of Chicago.

Search for Pinkus's nerve in adult *Amia* by macroscopic and microscopic methods failed to show the root which Allis described running back to the forebrain. The ganglion was found as Allis described it in larval *Amia*. A similar ganglion was found in larval stages of *Lepidosteus osseus*. The cells of the ganglion become scattered in *Amia* after the 50 mm. stage, when there are two hundred and fifty cells. In adult *Amia* the large cells from the larval ganglion were recognized to the number of one thousand on each olfactorius. They have the appearance of functional nerve-cells among the olfactory fibers as the latter break up into small bundles to enter the Schneiderian membrane.

There is some evidence that the cells are those of a sympathetic ganglion in *Amia*.

Each of the thousand cells does not send an axone back into the brain unless these fibers enter the olfactory bulb under the guise of osmotic axones. Such Golgi and Cajal preparations show morphological similarities to sympathetic cells. There are many points of similarity between Pinkus's nerve in the bony ganoids and Loey's nervus terminalis in sharks. There are two ganglia in the course of the nerve in *Squalus acanthias* and some of the cells are multipolar.

*The "Primitive Pores" and the Sensory Ridges of the Lateral Line of Polyodon spathula:* HENRY F. NACHTRIEB, University of Minnesota.

The "primitive pores" or pits. The many-layered epithelium of the skin passes, without change, into the mouth of each pit and then gradually becomes reduced as it passes toward the bottom of the pit, where it consists of two layers or of two distinct layers with interspersed pseudostratified areas. The cells are of two distinct types. The more conspicuous cells are large, clear columnar cells resting upon the basement membrane and containing centrally located nuclei with two to six distinct nucleoli (using the term in a general sense). The other type is, as a rule, a more or less flattened cell lying on the outer ends of the basal cells. They fit in closely between the rounded ends of the basal cells and consequently have an uneven lower surface. For convenience we may call them cover cells. Each cover cell contains a large, more or less irregularly shaped nucleus with, as a rule, but one nucleolus. Some of these cover cells clearly extend to the basement membrane, and various stages between a definite cover cell and a basal cell, with reference to both the cytoplasm and the nucleus, have been observed. A basal cell may be completely covered or send a small finger-like projection up between the con-

tiguous covering cells, or there may be a pore-like opening above it between the cover cells. The cells here called basal cells have been designated as supporting cells and the cells corresponding to what are here called cover cells have been designated sense cells, thus interpreting the pit as a sense organ. There are no structures supporting this interpretation. Well-preserved material and the elimination of all artifacts indicate that the primitive pits of *Polyodon* are simple glands that secrete a peculiar mucus-like substance.

The sensory ridges of the lateral canal are about .6 mm. long and in transverse sections cover the floor (or wall next to the muscles) of the canal. The epithelium is a simple flat epithelium excepting in the sensory ridges, where it is more or less columnar and consists of two types of cells. One is a relatively large clear cell resembling the basal cells of the primitive pits. These cells either do not rest on the basement membrane at all or only through very thin extensions. The other rests upon the basement membrane, and is a more slender and more irregularly shaped cell with a distinct oval nucleus. In the neighborhood of the clear cells, they generally overlap or cover the outer ends of the clear cells. Neither type of cell has any peculiarly differentiated free surface. As in the case of the primitive pits fine nerve fibrils end between the cells. A more or less evident network has been observed on some of the denser cells, which appear to be of two kinds, a supporting and a sensory cell. Clear cells discharging their contents into the canal are not infrequently seen in well-preserved material. While hairs or hair-like processes have not been definitely made out on any of these cells, the innervation and general appearance as well as the experiments of Parker and others indicate that these ridges are sense organs. There is no evidence that the primitive pits are

or ever have been a part of the lateral line system.

Microscopic preparations were shown in connection with the paper.

*Cranial Nerve Components in Amphiuma:*

H. W. NORRIS, Iowa College.

A preliminary outline of the more salient features of the origin and peripheral distribution of the cranial nerves of *Amphiuma* with reference to their components. Kingsley's account of the I. and II. nerves is confirmed. The eye-muscle nerves have the typical origin, but are all rudimentary, especially the VI. The IV. and VI. have not been described hitherto. The V. nerve is characterized by anastomoses with branches of the VII. Its origin is that described for *Necturus* by Kingsbury. The VII. nerve arises by five rootlets: three lateral line, one each communis and motor. In addition it receives general cutaneous and communis fibers from the IX. Branches: (1) *supra-orbital trunk*, lateral line (*ophthalmicus superficialis* VII.) and general cutaneous (V.); (2) *infra-orbital trunk*, lateral line (*buccalis* VII.), and general cutaneous (*maxillaris* V.); (3) *palatine*, communis; (4) *hyomandibular trunk*, lateral line, general cutaneous, communis and motor. The hyomandibular give rise to: the *alveolaris* (communis), *mentalis externus* and *mentalis internus* (lateral line), *jugularis* (general cutaneous, motor, together with some lateral line fibers), and the *ramus lateralis* (lateral line mostly, if not entirely). The *ramus lateralis* VII. is peculiar to *Amphiuma*. It runs to the posterior part of the body, but its neuromasts on the trunk of the body have not been determined. In addition to the anastomoses already mentioned the VII. nerve has the following: between the palatinus VII. and the *ophthalmicus profundus* V.; in the manner described for *Amblystoma* by Coghill; be-

tween the *alveolaris* VII. and *mandibularis* V.; between the *ophthalmicus profundus* V. and the *ophthalmicus superficialis* VII. and *buccalis* VII.; between the *alveolaris* VII. and the pretrematicus IX., two anastomoses; between the palatinus VII. and the pretrematicus IX., Jacobson's commissure; between the *jugularis* VII. and the IX.-X. ganglion, anastomosis IX.-X. and VII. The latter anastomosis has only general cutaneous and communis fibers. The IX.-X. nerve complex arises from the brain by five groups of rootlets. Peripherally the branches of the IX.-X. agree in general in their distribution with those of *Amblystoma* as described by Coghill. The first branchial nerve (IX.) contains only communis and motor fibers; the second and third branchial nerves (X.) contain general cutaneous, communis and motor fibers. A fourth branchial nerve, poorly developed, arises from the *ramus intestinalis*. The first spinal nerve (*hypoglossus*) arises by four rootlets, two dorsal and two ventral, as described by Kingsley. It does not anastomose with the X. nerve.

*The Participation of Medullated Fibers in the Innervation of the Olfactory Mucous Membrane of Fishes:* R. E. SHELDON, The University of Chicago.

In the carp (*Cyprinus carpio*) medullated fibers enter the submucosa region of the olfactory capsule distributing in part to the Schneiderian membrane. There they probably end in free nerve terminations, as there are no special end organs developed. These fibers are derived from the supra-orbital trunk, which is made up of general cutaneous fibers from the Gasserian ganglion (n. *ophthalmicus superficialis trigemini*) and sensory fibers from the facial (n. *ophthalmicus superficialis facialis*). This latter nerve is acustico-lateral from the *lateralis* ganglion of the facial and visceral sensory from the gen-

iculate. The fibers entering the mucosa are certainly not lateralis, as no canal or pit organs are there found; the fibers are also smaller than are the lateralis fibers. They may, therefore, be either general cutaneous or visceral sensory, with the preponderance of evidence in favor of the former, partly on the ground that the medullated innervation in mammals and birds, the other forms in which such fibers are known, is trigeminal and partly because the weight of evidence in the teleosts is against the supposition that visceral sensory fibers are present in this region. Young cod and gold fish were studied with reference to the presence of medullated fibers in the mucosa, but none could be demonstrated.

*The Ischio-coccygeal Plexus as a Pathway for Cutaneous Innervation in the Leopard Frog:* ELIZABETH HOPKINS DUNN, The University of Chicago.

Gaupp in the 1896 edition of Ecker's und Wiedersheim's "Anatomie des Froeschens" makes no mention of a cutaneous innervation by way of the ischio-coccygeal plexus, branches from which are there traced to the pelvic viscera and the posterior lymph heart.

In dissection of the ischio-coccygeal plexus of *Rana pipiens* the nervus coccygeus was found to send several terminal branches to a limited area of the skin about the cloacal opening.

At the point in the nerve at which the last visceral branch is given off a study of the relations of the individual fibers was undertaken. The last visceral branch contains from fifteen to twenty medullated fibers, the cutaneous portion about forty medullated fibers.

The small number of medullated fibers at this point makes possible the isolation of the individual fibers by teasing in gly-

cerin. One per cent. osmic acid was used as a fixing and staining reagent.

A careful study of material, including the trunk of the nerve above the point of branching and the visceral and cutaneous branches in their continuity with the main trunk, revealed in three consecutive preparations the division of at least one medullated fiber in each preparation occurring in the trunk just above the point of separation of the branches. Of these dividing fibers one limb passed toward the viscera while the other continued with the cutaneous portion of the nerve.

The weight of evidence seems to be in favor of the afferent character of these fibers.

If this be true, unless an independent functional value can be established for the individual neuro-fibrillæ in the neuraxis, it would appear that we have in such a distribution of the ramifications of a single nerve fiber an anatomical explanation for the close connection between visceral and cutaneous areas which has been suggested by the findings on the pathological side shown by Head's classic work on disturbance of sensation with reference to visceral disease.

A close physiological connection between the pelvic viscera and the adjacent regions may also be accomplished by means of such dividing fibers.

*Degeneration in the Ganglion Cells of Cambarus bartonii Gir:* HANSFORD MAC-CURDY, Alma College.

Within the last decade a large number of experiments have been performed on vertebrated animals to ascertain to what extent the nerve roots, ganglia and ganglion cells are affected when a nerve trunk has been severed. The results have varied greatly, but in by far the greater number of these experiments, distinct alterations in the size and structure of the parts affected

have been reported and in some cases complete degeneration of ganglion cells has been said to occur.

In a series of experiments on the abdominal ganglia of the crayfish, *Cambarus bartonii* Gir, ganglion cells have been found to undergo degeneration in twenty to thirty-eight days after the connectives anterior and posterior to the fifth ganglion have been severed. A smaller number of cells were affected in the fourth and the sixth than in the fifth ganglion. The histological changes in these ganglion cells are apparently similar and correspond to those described for similar structures in the nerve cells of vertebrated animals.

*Place-modes for the Sacrum and the First Hæmal Arch of Necturus*: FRANK SMITH, University of Illinois.

Data on the sacrum and first hæmal arch of 504 specimens of *Necturus* form the basis for place-modes of these two characters in specimens collected in Lake Erie at Venice, Ohio.

Of sacra involving two symmetrically placed sacral ribs, eight are modifications of the eighteenth vertebra, 347 of the nineteenth, 78 of the twentieth and two of the twenty-first. Two specimens have each two pairs of sacral ribs, one pair each on the nineteenth and one on the twentieth vertebra. Fifty-two specimens have two sacral ribs asymmetrically disposed. These involve two of the eighteenth, nineteenth, twentieth and twenty-first vertebra and are found in five of the six possible relations. Twenty-five have the right sacral rib in advance and 27 the left one. Fifteen specimens have three sacral ribs which involve two of the eighteenth, nineteenth and twentieth vertebrae and have seven of the eight possible relations. Four have the unpaired rib anterior to the paired ones, and the others have it posterior.

The first hæmal arch is on the twenty-

second vertebra in 177 specimens, on the twenty-third in 303 and on the twenty-fourth in 24. In two specimens a half hæmal arch is formed on the twenty-first vertebra. Of thirty sacral ribs borne on the eighteenth vertebra, all but one are associated with a hæmal arch on the twenty-second, and nearly all are in males. The correlation coefficient between the position of the sacrum and that of the first hæmal arch is  $.47 \pm .013$ .

Three hundred and nine specimens examined for sex include 129 males and 180 females. A comparison of the mean positions of the sacral ribs and of the first hæmal arches of the sexes shows clearly that the sexes should be considered separately in determining place-modes. Variability in both characters is somewhat greater in the males.

Mean of positions of attachment of sacral ribs in 504 Lake Erie specimens,  $19.19 \pm .014$ ; in 129 males,  $19.126 \pm .03$ ; in 180 females,  $19.28 \pm .025$ . Mean of positions of first hæmal arch in 504 specimens,  $22.70 \pm .015$ ; in 129 males,  $22.57$ ; in 180 females,  $22.82$ . These means are exceeded by the corresponding ones for the 100 specimens studied by Bumpus by an amount greater than that involved in the probable errors.

*The Habits and Structures of the Larva of Culex perturbans*: JOHN B. SMITH, Rutgers College.

The larva of *Culex perturbans* is unlike that of all other known culicid larvæ in that it does not live in free water or merely on the bottom surface. It works its way into the soft bottom mud a distance of from two to four inches and attaches itself by its modified anal siphon to the roots of grasses. By means of serrated processes it breaks through the outer surface of the roots, attaches itself by means of recurved hooks, and obtains its

supply of oxygen from the vascular system of the plants. The swamp areas inhabited by this species are those densely overgrown with grasses in which no other mosquito larva lives and among which no fish or other enemies are found. (See *Entomological News*, Vol. XIX., page 22, plates 3 and 4, January, 1908.)

*Note on a Trematode Parasite in a Hen's Egg from Northern Minnesota:* W. S. NICKERSON, University of Minnesota. (Read by title.)

*A Comparison between the Implantation Stages in Dipodomys and Geomys:* THOMAS G. LEE, University of Minnesota.

A study of a series of early developmental stages in *Dipodomys* taken previous to and during the process of the implantation of the ovum shows a general correspondence with the same stages in *Geomys* as previously described by the writer.

*Dipodomys* is the third rodent so far described in which the decidual cavity is formed in the ventral portion of the uterine mucosa outside of and independent of the uterine lumen. Perforation of the ventral portion of the uterine epithelium and the extrusion of the blastocyst occurs at a somewhat earlier stage of development than in *Geomys*. Consequently, the opening between the uterine lumen and the newly formed decidual cavity is at all times much smaller proportionally in *Dipodomys* than in *Geomys*. The blastocyst in *Dipodomys* does not become attached to the margin of this opening as is so characteristic of *Geomys*, but sinks down into the decidual cavity.

In both *Dipodomys* and *Geomys* there is for some time a functional yolk-sac placenta which is later substituted by an allantoic placenta.

*The Ecological Succession of Bird Associations:* CHAS. C. ADAMS, University of Chicago.

The breeding grounds of birds must be considered as fundamental in any attempt to determine their habitat relations. Those species which regularly breed in the same habitat form a bird association or society. The succession upon Isle Royale, Lake Superior, has been attempted by the study of the history of the environment correlated with the character of the birds. From a reef in the lake to the forested island there has been a definite environmental change; and, correspondingly, in all probability, a corresponding change in the bird life. Upon the habitat preferences of the present avifauna the general succession in the past may be roughly approximated. As the lake level lowered and the depressions became invaded by the forest, the aquatic association has been succeeded by the shore and bog-forest kinds; and these in turn by the birds frequenting the aspen-birch-balsam or maple forest. All habitats, under present conditions, tend to become transformed into that of the climax forest, with its avifauna or association. This method of environmental interpretation, as a problem of succession, gives a new point of view for the study of the development or evolution of the avian environment and the "struggle for existence" among birds.

*A Statistical Study of Midsummer Birds of Illinois:* S. A. FORBES, University of Illinois.

This paper contains a preliminary statement of some of the more general results of a census of summer resident birds of Illinois, giving the entire bird population of a strip 150 feet in width and 428 miles long (12 square miles), one third of this area being in southern, one fourth in central, and two fifths in northern, Illinois.

The method of the enumeration was such as to give the numbers of each species found on measured areas, taken at random, of each crop or other distinguishable kind of surface. The responsible observer, Mr. A. O. Gross, determined 7,740 birds belonging to 85 species—an average of 645 birds to the square mile, of which 18 per cent. were English sparrows. On this basis, the total summer population of the state numbers about 30,750,000 birds, of which five and a half millions were English sparrows. Eighty-five per cent. of these birds belonged to one fourth of the species. The ten most abundant species, and the numbers seen of each, were as follows: English sparrow, 1,414; meadow-lark, 1,025; bronzed grackle, 900; mourning-dove, 461; dickcissel, 393; red-winged blackbird, 347; prairie horned lark, 296; flicker, 197; robin, 194; and field sparrow, 186.

The English sparrows decreased in numbers per square mile from north to south (perhaps because of a diminishing population southward and a consequent progressive diminution of their breeding areas), 100 sparrows in northern Illinois being represented by 77 in central and 56 in southern; but the native birds increased from north to south, apparently for climatic reasons—100 in northern Illinois being represented by 116 in central and 129 in southern. The same gradation was still more pronounced in winter residents, which averaged 384 birds to the square mile in northern, 582 in central and 832 in southern, Illinois. The general average for the whole state and the entire year, as represented by 1,591 miles of travel and a census area of 44½ square miles, was 722 birds to the square mile.

By comparison of the midsummer numbers with the average for the fall migration period, a wave of denser population was detected, running from north to south

and rising with the progress of the migration. The central Illinois average for October was 2.3 times that for July, August and early September.

The original relation of the Illinois bird fauna to prairies was still discernible in the fact that half of these summer birds were found in pastures and meadows, although only a little over a third of the area inspected was in grass. Corn fields, on the other hand, which covered 32 per cent. of the area, contained but 15 per cent. of the birds, and these most largely English sparrows.

As an example of the local and numerical distribution of species, that of the meadow-lark was given, and as an example of the composition of the bird fauna of an ecological situation, the birds of the pasture were separately discussed. Meadow-larks, while numbering 85 to the square mile for the whole area covered, were very unequally distributed, averaging 266 to the square mile in fields of stubble, 205 in meadows, 144 in pastures, and 10 in corn fields, and not occurring at all in forests or among shrubbery. They increased notably in number from north to south—100 in northern Illinois being represented by 175 in central and 215 in southern.

Pasture lands were the preferred resort of the most abundant midsummer species, and contained 27 per cent. of all the birds seen. In average density of population, however, they were surpassed by meadows, which contained 920 for each square mile, to 878 in pastures, 562 in stubble and small grain, and 300 in fields of corn. The commonest pasture birds were the English sparrow, the crow-blackbird, the meadow-lark, the horned lark, and the field sparrow, abundant in the order named, and together making more than half the summer residents of the pasture lands of the state.

The impression made by this general examination of the present bird population of the state of Illinois was that of a remarkable flexibility and tenacity of the associate and ecological relationships of birds in the face of revolutionary changes in their environment. Apart from the results of the introduction of the English sparrow, and the direct destruction of game birds and birds of prey, the main effect of human occupation seems to have been the withdrawal of most of the prairie birds from the area devoted to Indian corn, and their concentration in pastures, meadows, and fields of small grain—situations which most nearly resemble their original habitat.

*Significant Changes in the Breeding Ranges of Certain Birds of the Ohio Valley and Lower Lake Region:* LYNDY JONES, Oberlin College.

These changes, during a period of seventy years, are a gradual but decided shifting northward of the breeding areas of twenty-five species of birds, or fully twenty per cent. of the breeding birds of the state of Ohio. The movement can not be accounted for by the changes attendant upon the settlement of the region, because the breeding habitats have not been materially changed. Rather the northward movement seems to be the expression of a gradual elimination of the less fit and as gradual an improvement of the species.

*The Relation of Ecology to General Biological Problems:* A symposium by H. C. COWLES, V. E. SHELFORD, C. C. ADAMS, the University of Chicago. To be published in full in SCIENCE.

*A Study in the Sex-ratio in Drosophila Ampelophila:* W. J. MOENKHAUS, University of Indiana.

The sex-ratio in *Drosophila ampelophila* is 1 male to 1.14 females. The sex-ratio is inherited. If the sex-ratio of many pairs

of this species taken from the same parents as determined in different pairs shows a wide range of variation in this respect. The ratio may vary from a slight preponderance of males to a strong preponderance of females in a proportion of 1 to 2 or greater. By breeding the offspring from pairs showing a selected ratio, these again show a ratio approaching that of their parents. Thus, by selection, a strain in which the females bore a relation 1.6 to 1 male was produced. This ratio, by selection, can be maintained. A male strain has not yet been attempted.

By mating females from the "female" strain with males from a strain in which the sex-ratio is 1 to 1, and *vice versa*, the sex-ratio of the offspring is in every case that of the strain from which the females were selected. From the results in five such experiments it is concluded that in this creature the sex is determined altogether, or nearly so, by the female, the male having nothing or little to do with it.

The objection that might easily be brought forward, that the selection in these experiments may be nothing more than the selection of those pairs in which one sex or the other tended to die and, hence, led to a preponderance of one sex or the other, has not been met satisfactorily experimentally, but it is not regarded as a factor of any importance.

THOMAS G. LEE,  
*Secretary*

UNIVERSITY OF MINNESOTA  
(To be concluded)

#### SCIENTIFIC BOOKS

SCIENTIFIC PUBLICATIONS OF THE AMERICAN  
MUSEUM OF NATURAL HISTORY FOR 1907

IN Volume XXIII. of the *Bulletin* of the museum there are almost one thousand—978, to be exact—printed pages, comprising thirty-six separate papers from nineteen authors, with fifty-three plates and eighty-three text figures. Many papers are of typical tech-