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, MAY 10, 1907

CONTENTS

Zoology at the New York Meeting: PROFESSOR C. JUDSON HERRICK 721

Scientific Books:—
Report of the Wellcome Research Laboratories: PROFESSOR HENRY B. WARD. *A 1671 English Version of Nicolaus Steno's de solido intra solidum naturalitur contento:* PROFESSOR J. B. WOODWORTH 737

Societies and Academies:—
The Society for Experimental Biology and Medicine: PROFESSOR WM. J. GIES. *The Biological Society of Washington:* M. C. MARSH 739

Discussion and Correspondence:—
The First Species Rule: PROFESSOR JOHN B. SMITH. *The Anthropological Exhibits in the American Museum of Natural History:* HENRY L. WARD. *Magazine Science:* CHRISTINE LADD FRANKLIN 744

Special Articles:—
The Ether Freezing Microtome in Botanical Technique: E. M. FREEMAN 747

Astronomical Notes:—
The Yale Parallaxes: PROFESSOR S. I. BAILEY 749

The American Association for the Advancement of Science—the Plattsburg Meeting of the Section of Geology and Geography: DR. F. P. GULLIVER 751

The Leicester Meeting of the British Association 753

The American Museum of Natural History .. 754

The Second Annual Meeting of the American Association of Museums 755

The Carnegie Institution and a Department of Anthropology 756

Scientific Notes and News 757

University and Educational News 760

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ZOOLOGY AT THE NEW YORK MEETING

I

AT the convocation week meetings held in New York, December 27, 1906, to January 2, 1907, Section F of the American Association for the Advancement of Science and the Eastern Branch of the American Society of Zoologists held joint meetings throughout for the reading of papers. In the forenoon of Friday, December 28, there was a joint session of these two societies with Section G, devoted to papers on animal and plant breeding, and in the afternoon of the same day the societies joined with the American Society of Naturalists in a discussion on the biological significance and control of sex, which has been published in full in SCIENCE for March 8. Section F and the Society of Zoologists held separate business sessions, the proceedings of which follow.

SECTION F

A business meeting was held December 27 for the election of officers, and the section was represented in a committee of the council which recommended the appointment by the president of the association of a committee to arrange a suitable memorial of the fiftieth anniversary of the publication of the 'Origin of Species.' The officers for the ensuing year are as follows:

Vice-president and Chairman—E. B. Wilson, New York.

Secretary—C. Judson Herrick, Granville, Ohio.

Member of Council—Herbert Osborn, Columbus.

Member of General Committee—E. L. Rice, Delaware, Ohio.

Sectional Committee—E. B. Wilson, E. G. Conklin, C. Judson Herrick, H. B. Ward (one year), Frank Smith (two years), W. E. Ritter (three years), A. M. Bleile (four years), A. L. Treadwell (five years).

AMERICAN SOCIETY OF ZOOLOGISTS

The fourth annual meeting of the Eastern Branch and the seventeenth annual meeting of the society since its establishment as the American Morphological Society elected the following officers for 1907:

President—Charles B. Davenport.

Vice-president—F. H. Herrick.

Secretary-Treasurer—H. E. Crampton.

Member of Executive Committee (to serve three years)—W. R. Coe.

Eleven persons were elected to membership, making the total membership of the Eastern Branch 135. A grant of $125 was voted toward the expenses of the International Zoological Congress to be held in this country next August.

Professor Crampton tendered his resignation as secretary-treasurer, and after adjournment of the session C. Judson Herrick was appointed by the executive committee to fill the vacancy.

JOINT PROGRAM

The Functions of the Nervous System of the Razor-shell Clam: G. A. Drew, University of Maine.

On the Sense of Sight of Spiders: A. Petrunkevitch, Indiana University.

The Sense of Vision in the Dancing Mouse: Robert M. Yerkes, Harvard University.

That brightness vision is fairly well developed in the dancer is shown by its ability to discriminate blacks, grays and whites. Color vision is extremely poor. There is some indication of the discrimination of red and green and of red and blue, but none whatever of blue and green. All my experimental tests as well as my observations of the habits of the mouse support the conclusion that such visual guidance as is received results from stimulation by brightness differences. There are many reasons for believing that the red end of the spectrum is much lower in brightness value for the mouse than for man. The general behavior of the dancer and the results of form, brightness and color tests show that vision is not very important in the life of the animal.

An Experimental Study of the Image-forming Powers of Various Types of Eyes: Leon J. Cole, Rhode Island Agricultural Experiment Station, Kingston, R. I.

The responses of certain phototropic animals to two areas of light of different size, but of equal intensity, were used as criteria in drawing inferences as to the image-forming powers of their eyes. To one side was a ground-glass, lighted from behind, which gave an evenly illuminated area 41 cm. square. To the other side was practically a point of light; but at the position midway between them, where the experiments were performed, the intensities of the two lights were equal. Eyeless forms (the earthworm was used) turned practically an equal number of times toward each light, showing no power of discriminating between them. Animals with 'direction eyes' were but little better in this respect (*e. g., Bipalium, Oniscus,* larva of *Tenebrio*). On the other hand, animals with well-developed 'compound eyes' (*Vanessa, Ranatra*) and 'camera eyes' (frogs) discriminated readily, positive animals turning much more often to the large light, and negative animals more often to the small. This discrimination was taken as evidence of image-formation by the eyes. Frogs

(*Acris gryllus*) with the skin covered but eyes exposed reacted like normal frogs; without the use of the eyes their responses corresponded to those of the earthworm.

We have thus a physiological test of the image-forming powers of the eyes, and in these experiments it corroborated in the main inferences which would be drawn from a study of the structure of the eyes in question.

This paper is published in Proc. Am. Acad. Arts and Sciences, Vol. 42, No. 16, pp. 335–417, Jan., 1907.

The Significance of the Grasping Antennæ of Male Harpacticoid Copepods: L. W. WILLIAMS, Harvard Medical School.

This paper has been published in SCIENCE for February 8.

Further Observations on the Behavior of Tubicolous Annelids: CHAS. W. HARGITT, Syracuse University.

Following up the work done on these animals and reported elsewhere, the writer has extended the observations to aspects of behavior other than those already recorded. Three points are concerned in the following observations:

First, a study of behavior under natural conditions of environment. This has been possible in quiet pools near low tide lines. Experiments on *Hydroides dianthus* with shadow stimuli, or light intensity of varying degree, under these conditions have confirmed in all essentials those made last year.

Experiments as to tactile responses showed considerable variations as compared with the former series. This may be attributed to the fact that specimens living under these conditions become more or less inured to similar stimuli from the actions of waves which naturally buffet them almost constantly.

Second, experiments on the relative sensory acuteness of specimens from deep water, about twenty fathoms, compared with those from shallow waters, one to three or four fathoms. In cases tested there was shown a definite preponderance of positive reactions among the latter, and a corresponding preponderance of negative responses in the former.

Third, a comparative study of the aspects of behavior shown in the growth of colonies taken from shore waters, subject to the action of waves, and those from quiet waters of bays, etc., shows an unmistakable variability in the aspects of the tubes, which clearly indicates environmental adaptation. Furthermore, specimens growing in an environment, such as marly bottom, or silt, or other similar condition, show the same evident response of adaptation. On the other hand, specimens growing along shore lines, or on rocky bottoms, show likewise the unmistakable response natural to such condition. Not a single colony among hundreds along the shore lines showed any free and vertical tubes. Likewise specimens dredged from muddy bottoms showed the erect and vertically directed tubes which would bring the animals above the obstructing mud.

Any careful consideration of the facts would hardly fail to convince one that no single factor, such as heliotropism, or geotropism, or any other tropism alone, was adequate for their explanation.

Rhythmical Pulsation in Animals: ALFRED G. MAYER, Carnegie Institution of Washington.

Experiments made at the Tortugas Marine Laboratory of the Carnegie Institution upon *Cassiopea, Salpa, Lepas* and the loggerhead turtle give results as follows:

Rhythmical pulsation can be sustained only when a strong stimulus is counteracted by an inhibitor, so that the pulsating organism is maintained at or near the threshold of stimulation in a state analo-

gous to that of unstable equilibrium, thus allowing weak internal stimuli to produce recurrent movement.

In the lower marine animals the NaCl, calcium and potassium of the sea-water combine to form a powerful stimulant, which if unchecked would produce only sustained tetanus, but the magnesium overcomes this effect by its anesthetic (diastolic) influence.

The pulsating organs of terrestrial animals are also stimulated by optimum combinations of NaCl, with potassium and calcium, and this is held in check by a definite proportion of magnesium.

A Ringer's solution resembles this optimum combination of NaCl, calcium and potassium, and is only a stimulant, not an inorganic food. It must be counterbalanced by magnesium in order to enable it to sustain pulsation indefinitely.

In *Cassiopea* any paralyzed strip of sub-umbrella tissue, cut in the shape of a closed circuit, will remain indefinitely in rhythmical pulsation, if once a contraction wave be started in the circuit. Every time this wave returns through the circuit of tissue to the place whence it started, it is re-stimulated and sent forth anew, and being thus reinforced at each return it is sustained indefinitely.

In the scyphomedusa, *Cassiopea,* the diffuse nervous or epithelial elements of the sub-umbrella transmit the pulsation stimulus to which the muscles respond by contraction.

The peripheral muscular layer of the wall of the loggerhead turtle's heart is the only part actively concerned in the rhythmical movement, and the internal cavernated mass of the heart's tissue may be removed without checking the pulsation. This peripheral part of the muscular wall of the heart tends to maintain itself in pulsation very much as will circuits made of the sub-umbrella tissue of *Cassiopea.*

The pulsation-stimulus acts solely upon the peripheral muscular layer of the heart's wall, the inner cavernated tissue remaining passive.

The above is a brief review of Publication No. 47 of the Carnegie Institution of Washington, 'Rhythmical Pulsation in Scyphomedusæ,' 1906.

The Interrelation of Sensory Stimulations in Amphioxus: G. H. Parker, Harvard University.

To weak acid solutions and other like mixtures the anterior end of *Amphioxus* was found to be most sensitive, the posterior end less so, and the middle trunk region least sensitive. To the pressure of a camel's hair brush, the middle region was less sensitive than the two ends, which, however, were not distinguishable one from the other by this method of stimulation. To a current of warm water (40° C.) the anterior end was most sensitive, the middle less, and the posterior end least. There were no reactions to a current of cold water (2° C.). To a fine beam of strong sunlight, previously passed through water to eliminate heat, the anterior end including the 'eye spot' was not sensitive, the region immediately behind the 'eye spot' was most sensitive, the posterior region slightly less so and the middle region least so.

The distribution of sensitiveness to light corresponds to the distribution of the pigment cups in the central nervous organ and these cups are without doubt the mechanisms concerned with the reception of light. The distributions of the other classes of sensitiveness are in mutual agreement, and, from the nature of their stimuli, these classes are doubtless represented by integmentary nerve terminals. To what extent these classes are independent may be inferred through the effects of exhaustion. After the tail of *Amphioxus* has been repeatedly stimulated with weak acid, the

animal ceases to respond to this stimulus but is still normally sensitive in that part of its body to heat or to mechanical stimulation. In a similar way after exhaustion to mechanical stimulation or to heat stimulation, the particular part of the body experimented upon is still sensitive to the other classes of stimuli. Exhaustion to light stimulation has no effect upon the sensitiveness to the other classes of stimuli. These observations lead to the conclusion that light, heat, mechanical and chemical stimuli are received by physiologically separate mechanisms and that these mechanisms are located in the skin except in the case of light, whose receptive organs are the pigment cups in the central nervous organ.

Analysis of the Cyclical Instincts of Birds: FRANCIS H. HERRICK, Western Reserve University.

The behavior of wild birds is primarily determined by a number of commanding instincts of ancient origin. These cardinal instincts are of two kinds, namely: (1) *continuous instincts,* which are needed for the preservation of the individual, such as preying, fear, concealment and flight, and (2) *cyclical instincts,* which are necessary for the maintenance of the race. By cyclical instincts we mean those discontinuous, recurrent impulses which attend the reproductive cycle, and which may be described as parental instincts.

The cyclical or parental instincts as a rule recur with almost clock-like precision, in spring or summer, with repetitions within the breeding season in certain species. They are modified by the continuous instincts, such as fear, and the instinctive behavior as a whole is liable to modification at every point by intelligence. Neglecting such changes for the present, we will briefly analyze the cyclical instincts, reserving details and tabular statements for a fuller presentation.

The reproductive cycle is made up of a series of terms, representing discrete acts or chains of actions which follow in a definite succession. Eight or more terms may be recognized, many of which, such as brooding and feeding the young, are recurrent within the series. The cycle may be graphically represented by a number of tangent circles, each one of which stands for a distinct sphere of influence, or subordinate series of related impulses, named and numbered as follows: (1) Spring migration; (2) courtship and mating (often attended by song); (3) selection of nesting site and building nest (often accompanied by the fighting instinct); (4) egg-laying; (5) incubation—including care of eggs, such as shielding, rolling, cleaning and covering (fear often completely blocked by brooding instinct); (6) care of young in nest, subject to the following analysis: (*a*) feeding young, including capture and treatment of prey, return to nest (pause), call-stimulus, testing reflex response of throat, watching for reflex response (pause); (*b*) inspection of young and nest; (*c*) cleaning young and nest; removal and disposition of excreta; (*d*) incidental care of young and incidental behavior in this and other terms of cycle, such as brooding, shielding or spreading over young whether sitting or erect, bristling and puffing, preening, gaping, stretching and yawning, guarding and fighting; (7) care and incidental education of young when out of the nest; guarding, feeding, play, and other instinctive acts; (8) fall migration. Beginning at 2, 3 or 4, according to circumstances, the cycle may be repeated once or oftener within the season.

The coordinated instinctive responses of the young begin in the sixth term, and are mainly as follows: (6) Initial responses at moment of hatching or shortly after,

including grasping movements of limbs, elevation of head, opening of mouth, and the swallowing reflex in response to contact of bill of old bird or of food in deep part of throat (in the altricial species); characteristic actions in muting following feeding, in response to the stimulus of food and the attitude of inspection in adult; call-notes, pecking and gaping, stretching and spreading in response to heat, flapping, fear and flight; (7) calling (teasing), following, crouching and hiding, play, imitation, preying and flight; (8) fall migration.

The formula of the reproductive cycle given above is a composite, which with slight changes will apply to most of our common wild birds. In the most aberrant cases of behavior, where the parental instincts have been reduced to a minimum as in the cow buntings of North America and in some of the megapodes, the cycle ends abruptly with term 4, and in the cowbird there is no attempt to either build a nest or to conceal the eggs.

Some Features in the Behavior of the Starfish: H. S. Jennings, Johns Hopkins University.

The paper gave an analysis of the righting reaction of the starfish, and showed that the animal could, by a systematic course of training, be caused to form a habit of righting itself in a certain definite way.

Movement and Problem-solving in Ophiura brevispina: O. C. Glaser, University of Michigan.

1. *Ophiura brevispina* moves in practically all of the ways possible to a pentaradiate animal.

2. Its behavior in removing obstructions from its arms is not perfected by practise under ordinary conditions.

3. Preyer's conclusion that Ophiurans are intelligent is not substantiated by this study; for not only is it impossible to demonstrate 'resolution' or improvement, by the method that he employed, but the assertion that an animal is intelligent because when stimulated it performs varied movements until some one of these brings about cessation of the stimulus, leads into difficulties, for these animals often perform in instantaneous succession movements that fail for the same reason. *Ophiura,* moreover, hardly ever executes a single movement, but usually a considerable number. Each of these on Preyer's view results in learning, but it is impossible without striking evidence to the contrary, to believe that Ophiurans can learn half a dozen things at the same time. If some of all the movements performed at a certain instant are 'correct,' the case is farther complicated in that some of all the things which the animal learns fall into the category of successes, some into the category of failures.

4. The reason why *Ophiura brevispina* does not improve under ordinary circumstances is probably due to its versatility. This animal can perform a surprising number of movements. Of all these some are better fitted to meet a certain difficulty than others, but a considerable number will serve the purpose. Where the number of solutions to a problem is large, it is not surprising that no particular method of solution should be perfected, viz.: that resolution should not occur.

The Breeding Habits of the Florida Alligator: Albert M. Reese, Syracuse University.

The habits of the alligator were studied during parts of three summers in the Everglades, in the swamps of central Florida, and in the Okefenokee Swamp. The time of laying is the month of June, usually during the second and third weeks. The nests, which are built on the bank near

the caves of the alligators, vary considerably in size, and consist of a very compact mass of damp, decaying vegetation. They probably serve more as a means of keeping the eggs moist and at a constant temperature than as a means of heating them. The average number of eggs in a single nest is about thirty, forty-eight being the greatest number found in one nest. The eggs are so closely packed in the nest that it seems hardly possible that the young alligators, on hatching, should be able to dig their way out; it is possible that the female who laid the eggs may hear the noise made by the young before hatching and may dig them out of the nest before they suffocate. The period of incubation is probably about eight weeks, and sometimes is found to have begun before the eggs are laid, so that eggs taken directly from the oviducts may contain well advanced embryos. There is considerable variation in the size of the eggs, the variation in long diameter being greater than that in short diameter. The average long diameter of the four hundred eggs measured was 73.742 mm. The average short diameter was 42.588 mm.

An Electric Wax-cutter for Use in Reconstructions: EDWARD L. MARK, Zoological Laboratory, Harvard University.

The wax-cutter is made by heating a platinum wire about 0.4 mm. in diameter by means of an electric current regulated by a rheostat consisting of ordinary electric lamps of different candle power and arranged in multiple. To give the wire alternating motion parallel to its length, it is stretched in a frame made of a bent steel rod, one portion of which is substituted for the 'needle-bar' of an ordinary household sewing machine. The melted wax is withdrawn through a copper tube—kept hot by passing through a small hot-water tank—attached to a suction pump of the Bunsen type.

The apparatus is fully described and illustrated in a number of the *Proceedings* of the American Academy of Arts and Sciences published in March.

The Microscopic Structure of the Stigmal Plates of the Tick Genus Dermacentor: C. W. STILES, Washington, D. C.

The Circulatory System in Nereis: H. R. LINVILLE, New York.

The general plan of the circulatory system and the circulation in Nereis, as observed in living individuals, is a median dorsal vessel in which the blood flows anteriorly as the result of peristaltic waves of contraction in the wall of the vessel, and a larger median ventral vessel in which blood flows posteriorly without contraction of the wall. Anteriorly the dorsal vessel branches at the cephalic plate into four vessels, and the blood is carried downward and posteriorly through a set of capillaries in the region of the pharynx to the ventral vessel. Posteriorly the last three somites of the trunk have single pairs of blood vessels which carry blood upward into the dorsal vessel. Beginning at the eleventh trunk somite and extending to the fourth somite from the posterior end, there is a complicated arrangement of lateral vessels and capillaries. At a point near the anterior end of each intermediate somite a pair of 'hearts' lying close to the intestine carry blood downward in peristalic waves, to a pair of short vessels which connect with the ventral vessel. A portion of the blood carried by the hearts passes into these short connecting vessels, and then into the ventral vessel or out into another pair of blood-vessels that start from the ventral ends of the short connecting vessels and extend to the nephridia in the ventral rami of the parapodia. The remainder of the blood from the hearts goes into a pair

of vessels, which are continuous with the hearts but bend outward and upward and pass through the dorsal musculature into the somite in front, to sets of skin capillaries there on the dorsal rami of the parapodia and on the dorsal surface of the somite. Blood passes through these sets of capillaries, with the blood from the nephridial capillaries, into a pair of vessels which empty blood into the dorsal vessel immediately after the peristaltic wave of contraction in the dorsal vessel has passed the point of connection.

The Relation of Variability to Food Supply as illustrated by the white daisy, Chrysanthemum leucanthemum L. and the yellow perch, Perca flavescens Mitch.: L. B. Walton, Kenyon College.

Notwithstanding the numerous biological problems which have been attacked by means of statistical methods during the last ten years, an absence of evidence concerning the effect of food supply upon the variability of organisms exists. It was with a view toward obtaining data bearing upon this particular problem that the present investigation was undertaken. While the natural environment by no means furnishes conditions for obtaining the best results, it seemed advisable, at least in a preliminary survey of the subject, to adopt such a method.

In the first part of the investigation results were obtained from the ray flowers in two groups of the common white daisy (*Chrysanthemum leucanthemum* L.), 500 heads growing on rich soil (group A) and 500 heads growing on poor soil (group B) were examined. The specimens were collected on the same day and from localities approximately one mile apart. While the mode (33) and the mean (28.786) were much greater in specimens growing on rich soil (cf. Ludwig, Tower, Shull, etc.) than in those on poor soil (21) (25.632), the index of variability in each group was approximately the same taking into consideration the probable error.

In the second part of the investigation results were obtained from the number of pore-bearing scales in the lateral line of two groups of yellow perch (*Perca flavescens* Mitch.) obtained in Lake Erie. The one group (group A) was procured from a locality (cove in Sandusky Bay) where there was every reason to believe that the food supply approached the maximum, while the other (group B) was collected from the rocky shores of an island some ten miles distant where the food supply apparently approached the minimum. Again the index of variability showed no decided difference when the probable error was considered.

In connection with the ray flowers of the daisy it is of interest to note that specimens from rich soil exhibited a tendency toward an even number of ray flowers, while those from the poor soil had a tendency toward an odd number of ray flowers. This however may be a coincidence, although taken into consideration with the differences, a somewhat remarkable one. No decided tendency toward the Fibonacci series was apparent.

The computations were made by the ordinary method, checked by logarithms and a Burrough's adding machine. There are a number of possible errors minimizing the value of the results. These, together with the literature bearing upon the subject will be considered in the final paper.

While the above results suggest that food supply does not materially affect variability, it is evident that work upon a larger number of specimens, as well as carefully controlled experimental investigations, where the effects of different groups of stimuli may be segregated, will be necessary before any final conclusions may be drawn.

A Study in Variation, Geographical Distribution and Mutation in Snails of the Genus Partula from Tahiti: H. E. CRAMPTON, Columbia University.

In presenting the more important results of a recent study in the field of terrestrial pulmonates of the island of Tahiti, belonging to the genus *Partula,* it was shown that different valleys contain forms that on account of their more or less complete isolation have come to differ in correlation with their geographical proximity or remoteness. The vital conditions that limit the snails of this island to their particular stations are dryness peripherally, where the valleys debouch upon the coastal alluvial plain, and lower temperature centrally. Only rarely may stragglers pass from one region to another.

Evidence was adduced showing that 'mutations' have arisen at various recent times, the observations of Garrett and Mayer, taken in connection with the results of the writer, making it certain that at least three forms have thus originated, at dates that may be determined with substantial accuracy. It was furthermore shown, in corroboration of Mayer's contention, that the environmental conditions can not be regarded as the factors that have produced the several specific and varietal differentia exhibited by the Tahitian snails.

On a Case of Reversion induced by Cross-Breeding and its Fixation: W. E. CASTLE, Harvard University.

This paper has been published in SCIENCE of January 25.

Reversion: C. B. DAVENPORT, Cold Spring Harbor, Long Island.

Observations on the Habits of Salt Marsh Mosquitoes: JOHN B. SMITH, New Brunswick, N. J.

During the summer of 1906 a close watch was maintained on the development of mosquitoes on the salt marsh area near Elizabeth, New Jersey. In all ten distinct broods developed, the first observed April 19 and coming to maturity May 2; the tenth observed October 12 and coming to maturity soon after. Larvæ were found however until November 30 after even heavy frosts. Broods I., II. and III. were mostly *Culex cantator*; in brood IV., *C. cantator* and *C. sollicitans* were almost equal; brood V. had 80 per cent. *cantator,* and after that *C. sollicitans* was in the majority in all cases. The latest larvæ, however, were *cantator.* There was a great difference in the habits of the various broods: I., II., IV. and VI. were migrants and left the marshes in great numbers; the others remained on the marshes or did not get very far inland. There seemed to be a relation between numbers and migrations, the heavy broods migrating most and farthest.

An Undescribed Species of Noctuid Moth from New York City: HENRY BIRD, Rye, New York. Illustrated by box specimens showing larvæ and habits.

New Evidence from Primitive Sharks on the Origin of the Limbs of Vertebrates: RAYMOND C. OSBURN, Columbia University.

Embryological studies on *Heterodontus japonicus* Dumeril, a cestraciont, and on *Chlamydoselachus anguineus* Garman, a notidanid shark, show that there is a deep-seated, primary similarity between the paired and unpaired fins embracing all the structures of the fins—skeleton, muscles, nerves, blood supply and ceratotrichia. The arguments recently advanced by the gill-arch theorists for the branchial origin of the paired limbs (viz., abortive muscle-buds, fusion of muscle-buds, collector nerves, discrepancy between muscle and fin rays, and fin-migration) are all disposed of by showing that these conditions may

exist in any fin, unpaired as well as paired. The pectoral girdle is proved to be not serially homologous with the gill arches. In Heterodontus the pectoral girdle is shifted forward during development toward the gill region instead of away from it as the gill-arch theory assumes. The attachment of the trapezius muscle, assumed by the adherents of the gill-arch theory to be 'an old relic of a former branchial musculature supplying the shoulder girdle,' is shown instead to be secondary. The pelvic arch has primarily no dorsal prominence homologous with the scapular portion of the pectoral arch, but, on the other hand, the pectoral arch passes through a stage similar to the pelvic arch when only the ventral portion is present. Hence neither of them is to be regarded as a modified gill arch. In all fins the condensation or thickening of the mesenchyme, from which the skeleton is later differentiated, begins always in the fin-fold in contact with the ectoderm and extends inward, and is thus of external origin in contrast to that of the gill arches which arises next to the endoderm of the pharynx. In the paired and unpaired fins the sequence of development of the various structures is identical. The above facts show such striking similarity between the paired and unpaired fins, in the development of all structures, and such contrast with the gills, as to strongly support the fin-fold theory of Thacher, Balfour and Mivart.

On the Structure, Development and Relationship of Blastoidocrinus (Billings 1859): George H. Hudson, Plattsburgh, Clinton Co., N. Y.

The only known species of the genus was described by Billings in Cam. Org. Rem., Decade IV. (1859). F. A. Bather in Part III. of the 'Treatise on Zoology' edited by E. Ray Lancaster gives it a family of its own and has placed it with *Asteroblastus* under Grade A, *Protoblastoidea* Bather (1899). The elaborate hydrosphere folds would cut it out of this grade, however, and while it has an ambulacral system like that of the Edrioasteroidea its brachioles would alone exclude it from that class. The present paper is based on a very perfect specimen (fragments only have been heretofore known), and on fragments and some thousand single and very perfect plates from specimens of different ages. The paper presents new and remarkable elements in Echinoderm structure, some from internal structures displayed by a section from the perfect specimen, and the development of many structures from five areas of 'primary meristem,' one each at the distal ends of the rays. Cystid, blastoid edrioasteroid and crinoid characters were briefly mentioned. The form has been made the type of a new order Parablastoidea. A more complete description is published in N. Y. State Museum Bulletin 107, p. 97.

Notes on the Periodical Literature of the Smaller Domesticated Animals: C. B. Davenport, Cold Spring Harbor, N. Y.

There is a mass of current periodical literature on the domesticated animals that is not taken cognizance of in the zoological bibliographies nor in those of agriculture. Consequently they are unknown to most zoologists. With the revival of scientific interest in breeding this literature becomes of great importance because it tells where stock is to be obtained and because it contains suggestive data on the factors of evolution. Taken together this mass of periodical literature constitutes a history of the current evolution of domesticated animals of the most detailed and intensive sort.

Origin of the Sperm-center in the Fertilization of Cerebratulus lacteus: NAOHIDE YATSU, Columbia University.

Since the discovery that a cytaster with a centriole may be formed *de novo*, the question has been raised as to whether the sperm-center may not be a cytaster produced by a stimulus exerted by the spermatozoon. This idea has led to the formulation of the chemical 'theory' of fertilization. It has, therefore, become important to examine the origin of the sperm-center. In studying the spermatozoon of *Cerebratulus lacteus* a definite granule was found in the middle piece, which takes a strong hæmatoxylin stain. After the entrance of the spermatozoon into the egg the middle piece swells up into a vesicle, and faint rays appear centering in the granule in the middle piece. The granule or centriole then escapes from the vesicle and becomes the center of the growing aster. At this moment there is no centroplasm or centrosome around it, the rays reaching the central granule. Later the central ends of the rays become obscure and the centroplasm is accumulated around the centriole. Then the centriole in the centrosome divides into two. But the daughter centrioles soon lose their centrosome and become naked. From this observation three conclusions may be drawn:

1. The centriole is actually introduced into the egg by the spermatozoon, excluding the possibility that the centriole in the sperm-aster arises from the egg.

2. The centrosome is derived from the egg substance.

3. The centrosome is not a permanent organ of the cell as has been thought by some cytologists.

A Graphic Method of Correlating Fish Environment and Distribution: ALBERT H. WRIGHT, Cornell University.

It is some years since ornithologists saw the advantages of some graphic means of representing complex bird waves and their coincident relation to physical conditions. In ichthyology, a schematic method whereby fish distribution and environment can be correlated would seem of material aid.

The study of a stream and its fishes involves the consideration of factors so numerous and so diverse and accumulates such a mass of data, that one is almost driven, perforce, to adopt some graphic method to make results appear quickly and clearly.

The chart described, presents the range of each species in the stream and the important physical conditions which obtain, namely: the nature and the configuration of the bottom; the depth at any given point; the surface of the water; the drop in the stream and the current conditions; the altitudes of the mouth, source and all intermediate points; the distances in miles; woodlands, swamps, falls, mill-ponds, dams in use and remains of dams, small and important tributaries and whether from the right or left side, bridges for landmarks, canals, stream across the divide, the width at any place, at every mile point valley cross-sections in which the geologic formations may be shown, etc.

Venation of the Wings of Paleozoic Dragon-flies: E. H. SELLARDS, University of Florida.

The paper relates specifically to the dragon-flies of the Permian and is a summary of results published in detail elsewhere. The structural characters of especial interest are found in the disposition of the veins of the radio-median area, and particularly in the position of the radial sector, which is observed in the case of a large and well preserved specimen, to cross the first two branches of the media as in the case of modern dragon-flies. The other main veins of this area are also in

essential agreement with the veins of the same area in modern forms. Such differences as occur are believed to be of less than ordinal value. The order Protodonata, established by Handlirsch, is not accepted; the Protodonates being regarded as a suborder of the Odonata.

Note on the Origin of the Mesoderm of the Polyclad, Planocera inquilina Wh.: Frank M. Surface, University of Pennsylvania.

According to Arnold Lang (1884) the mesoderm of the polyclads arises from the whole of the second and third quartets of micromeres. It had been long suspected that Lang was in error, but the subject was not investigated until 1898 when E. B. Wilson published some observations on a species of *Leptoplana*. He found that all the first three quartets contribute to the formation of ectoderm, while the mesoderm arises by budding in from cells of the second quartet. This mesoderm thus corresponds to the 'larval' mesoderm of annelids and molluscs. Wilson, however, found no evidence of mesoderm arising from members of the fourth quartet and thus in this one important particular the early development of the polyclads differed from the above-mentioned groups.

In working over the cell lineage of *Planocera inquilina* it has been definitely determined that in this species, mesoderm arises from the *posterior cell of the fourth quartet, i. e., 4d,* just as it does in annelids and molluscs. At the stage of about forty cells, *4d* buds into the interior a single large cell which later divides into a right and left moiety from which the mesodermal bands arise. Some of the mesoderm, however, arises from cells of the second quartet as described by Wilson.

Land Planarians in the United States: L. B. Walton, Kenyon College.

Leidy, at a meeting of the Philadelphia Academy of Science, August 12, 1851, presented a paper in which he described the first and only species of land planarian (excluding *Placocephalus kewensis,* an introduced form living in hot houses) which has thus far been found in the United States. To this he gave the name *Planaria sylvatica.* The five specimens he obtained were collected under flower pots, boxes, etc., in gardens at Philadelphia, and under pieces of bark, and old logs in the woods bordering Wissahicon Creek. On October 7 of the same year, after a more critical study of the specimens, he proposed a new genus for their reception, the name thus becoming *Rhynchodemus sylvaticus.* At a meeting of the society on August 24, 1858, he again referred to the subject stating that since 1851 he had found one specimen in the western part of Pennsylvania on Broad Top Mountain (August, 1857) as well as several specimens at Newport (July, 1858). Since this time no further observations concerning the collection of additional land planarians in the United States have appeared.

Consequently the occurrence of two distinct species of *Rhynchodemus* at Gambier, Ohio, is of considerable interest. The first form which may prove identical with the examples procured by Leidy at Philadelphia, was found on the partially decayed stem of a Virginia creeper, July 9, 1904, near Bexley Hall. Five specimens were obtained, while additional representatives have been found at the same place each succeeding summer. During November of the past year a single specimen was also taken under a stone in a meadow some three miles south of the preceding locality. The specimens mentioned agree closely with the description given by Leidy as well as with his drawing of the Philadelphia forms published in Girard's paper on planarians (*Ann. sc. Nat. Zool.,* 7 ser., pp. 145–310, 1894). The length is greater

however, while the anterior part is constricted as figured by Girard for the Newport specimens. It is evident that two and possibly three species were confused by Leidy under the one name. His material was given to Girard and thus far it has been impossible to locate it.

The second form occurring at Gambier is considerably smaller than the preceding one as well as much lighter in color. Only two examples have been found, both under stones in damp woods. It seems quite distinct from any of those taken by Leidy as well as the species tabulated by von Graff in his excellent monograph.

Some papers in preparation dealing with the anatomical structure of the forms will probably make clear their systematic position. Furthermore, it appears evident that land planarians are widely distributed over the United States and that by reason of their similarity to young snails, they have often been overlooked by collectors.

Some Little-known Shark Brains, with Suggestions as to Methods: BURT G. WILDER, Cornell University.

This paper continues that of which an abstract was printed in SCIENCE for May 26, 1905. Now first, so far as I know, are shown the brains of *Heterodontus* (*Cestracion*) and *Pristiophorus*. With the former the cerebrum and cerebellum resemble those of the 'acanth' (*Squalus acanthias*), indicating an antiquity little if any greater. Notwithstanding certain ectal resemblances of the two dentirostral genera, *Pristis*, the 'saw-ray' and *Pristiophorus*, the 'saw-shark,' their brains differ markedly, the latter's being the more primitive. Their inclusion within the same family or even the same division would seem to me an error less only in degree than would be their combination with *Xiphias, Polyodon* and *Psephurus* as 'Rostrata,' or than was Günther's association of Ganoids and Selachians as 'Palæichthyes,' aptly characterized by Gill as a 'piece of scientific gaucherie.' Upon encephalic grounds I think *Pristiophorus* and *Scymnorhinus* should be excluded from the Squalidæ, and *Sphyrna* from the Carchariidæ. The brain of each selachian genus is, I think, recognizable, but I am less certain as to family forms. The Notidanoid or Diplospondylous type is well marked, and includes *Scymnorhinus*. At present the rays can not be distinguished from the sharks in any such simple way as, *e. g.*, the Anura may be from the Urodela by the secondary fusion of the olfactory bulbs. Perhaps, in no shark is the prosocele so nearly obliterated as it seems to be in all rays. In no ray do the cerebral protrusions remain unconjoined as in some sharks; but, paradoxically, in no ray is there, as in several sharks, so nearly a complete obliteration of the evidence of their primary independence. Under 'methods' may be enumerated: (1) The need of well-preserved brains of all species; (2) maintaining the natural contours, especially of thinner parts, by injecting the preservative into the cavities; (3) making solid injections of the cavities; (4) exposing brains with a 'shoe-knife,' obliquely shortened; (5) exploring with the 'syringotome' or canaliculus knife; (6) the use of sheets of uniform size, say 35 x 45 cm., upon which, in a manner permitting change, are drawn outlines of the animal and of its characteristic parts, especially the brain; such sheets may be arranged and rearranged upon the wall so as to facilitate research and exposition to small classes.

The Primary Septa in the Rugose Corals: CLARENCE E. GORDON, Amherst Mass.

The number of these septa is still in dispute. The assertion of Professor Duerden that there are six protosepta is contradicted by other evidence of an important

nature. Professor Duerden's argument is not conclusive because he has not yet shown in what way a tetrameral plan of growth shown in the early condition of certain individuals can be in all cases the result of imperfect silicification. The possibility of acceleration is not denied and the very species that he studied show strong evidences of acceleration in development. Hence the uncertainty of reasoning from sections, about which there must always be a good deal of doubt.

Early Stages in Streptelasma and Allied Genera: Thomas C. Brown, Columbia University.

This paper considers an argument concerning the original tetrameral arrangement of the septæ in *Streptelasma* and allied genera of the rugose corals and describes the protheca as observed in these genera.

Fission in the Hydroid Corymorpha: Harry Beal Torrey, University of California.

Spontaneous fission occurs occasionally in Corymorpha, across heteromorphic stems. The latter are geotropic, both ends turning upward, and take the form of U's, attached at the loop, with free vertical limbs. The distal limb is the longer, with the larger and earlier hydranth.

The fission plane is first defined by a constriction in the loop of the U. The stem attenuates in this region, owing to the migration of proximal and distal limbs away from each other. The cœnosarcal canals are obliterated and the circulation characteristic of the stem ceases. This may be the cause of the disintegration which may appear here. Frustules arise on both sides of the constriction before fission is completed.

The new polyps, proximal and distal, are normal in all respects. Morphallaxis plays an important rôle in their complete development.

Variation during the Life-Cycle of Infusoria in its Bearings on the Determination of Species: Lorande Loss Woodruff, Williams College.

The data summarized, derived from the culture of various infusoria through long periods, suggest that it is customary to regard the structure most frequently observed in 'wild' Infusoria as too constant in character, and to overlook the fact that modifications occur throughout the life-cycle which are in no sense abnormal, and which must be taken into account in the determination of species.

1. *Oxytricha fallax,* for example, shows a variation of over 250 per cent. in length, and over 300 per cent. in width during the life-cycle.

2. The shape of the animal changes greatly at different periods of the life-cycle.

3. The form of the macronucleus alters exceedingly, not only toward the end of the life-cycle but also at periods of the highest reproductive activity. Peculiarities in shape are sometimes transmitted from generation to generation. During a cycle extending over about a year, the macronucleus was 'normal' in form for less than three months.

4. The number of micronuclei varies during the life-cycle. There is apparently a tendency toward numerical reduction during the early part of the cycle, and reduplication during the latter part.

5. The quantitative relation of cytoplasmic and nuclear material changes during the life-cycle. This is brought about by both cytoplasmic, and macronuclear and micronuclear changes.

6. The proportionate length of the ciliary apparatus varies, the cilia being longer during high reproductive periods of

the life-cycle. This is probably due to a reduction in size of the body unaccompanied by a proportionate reduction of the ciliary apparatus.

7. The general activity of the organism varies greatly. During periods of high division-rate, motion is exceedingly rapid, and in a general way may be said to diminish with the rate of division.

8. Stimuli produce different effects at different periods of the life-cycle. K_2HPO_4, for example, accelerated the division-rate of *Gastrostyla steinii* during the early part and retarded it toward the end of the life-cycle.

Notes on the Life History of the Nematode Hæmonchus contortus: B. H. RANSOM, Bureau of Animal Industry, U. S. Department of Agriculture.

Hæmonchus contortus, a nematode worm of the family Strongylidæ, which lives parasitic in the fourth stomach of ruminants is responsible for great losses among sheep in the United States, especially among lambs. The lambs become infected, through the medium of the pasture, from the adult sheep of the flock. Full grown sheep may be heavily infested and show little or no evidence of disease. Recent studies in the zoological laboratory of the Bureau of Animal Industry have brought out a number of interesting facts in the life history of *H. contortus.* The eggs of the parasite hatch out in the droppings of the host, and the embryos develop to the final embryonic stage, known as the ensheathed stage, in a period of time varying according to temperature, from three to four days at 95° F., to three to four weeks at 50° F. Ensheathed embryos crawl up perpendicular surfaces whenever the air is saturated with moisture, and by such migrations gain positions on grass blades when they are likely to be picked up by grazing animals. Ensheathed embryos when swallowed by a sheep develop to maturity in two to three weeks, but eggs and embryos which have not reached the ensheathed stage are not infectious when swallowed. The eggs and newly hatched embryos are quickly killed by freezing or drying, but ensheathed embryos suffer no apparent injury from freezing and may live in a dried condition for at least thirty-five days. When the temperature is 40° F., or below, the eggs remain dormant, and a small percent may retain their vitality for as long as two months, but none survived three months in the experiments tried. Embryos have been kept alive in cultures at a temperature of about 70° F. for as long as six months. Enclosures previously pastured by infested sheep were still infectious after remaining empty for seven months, from November to June. It is suggested that lambs may be kept from becoming infected with the parasite and the flock in course of time freed from infection by moving the flock from one pasture to another before the embryos have time to develop to the ensheathed stage in which they crawl upon the grass, the time being determined by means of cultures of feces from infested animals. Each time the flock is moved a culture is made by placing a small quantity of feces with sufficient water to make a thick paste in a wide-mouthed corked bottle and the culture exposed to out-door temperature. When ensheathed embryos begin to crawl up the inner surface of the bottle where they may readily be seen with the aid of a hand lens, the sheep are moved to another enclosure.

On the Place of Origin and Method of Distribution of Taste Buds in Ameiurus melas: F. L. LANDACRE, Ohio State University.

Taste buds appear simultaneously in the extreme anterior portion of the oral cavity

(ectoderm) and on the endoderm of the first three gill arches. Buds always spread posteriorly from these places of origin by discontinuous groups. Those of the pharynx spread back into the œsophagus and are continuous with the buds on the last gill arch. Those of the anterior oral cavity spread back in the mouth by discontinuous groups until they reach the area occupied by the pharyngeal buds and they also spread back on the outer surface of the body by discontinuous groups until they reach the posterior portions of the body.

No buds spread from the pharyngeal group to the outer surface of the body. The first taste buds to appear on the outer surface are continuous with those just inside the lips. All the remaining buds appear in discontinuous groups determined partly by the distribution of the rami of the V. and VII. nerves, but not entirely so. There are six well defined groups of buds on the outer surface of the body and two in the anterior oral cavity distinct from the dorsal and ventral lip buds.

The appearance of buds in the oral and cutaneous areas in detached groups spreading from anterior to posterior seems to indicate the order in which specialized communis fibers reach the surface through rami of the V. and VII. nerves. A comparison of the rami bearing fibers in *Ameiurus* with other types shows a very great degree of variability in the geniculate ganglion of the VII. nerve as to the number of rami through which it may send communis fibers and as to the time at which it sends them in *Ameiurus*. The functional needs of the organism, such as changes in the methods of seeking and locating food, seem to determine the direction of spreading and also to be more important factors in determining the manner of appearance (*i. e.*, in detached groups) than the mere anatomical arrangement of trunks and rami of the nerves, so that the discontinuous groups may be designated as functional groups.

The Central Reflex Connections of Cutaneous Taste Buds in the Codfish and the Catfish. An Illustration of Functional Adaptation in the Nervous System: C. Judson Herrick, Denison University.

The taste buds which occur in the outer skin of siluroid and gadoid fishes have been thoroughly studied anatomically and physiologically, their innervation worked out and their central reflex connections compared with those of the tactile nerves from the same cutaneous areas. The peripheral gustatory and tactile nerves of the cod and the catfish are the same in principle, with the exception of the location of the most sensitive areas used in the locating of food. This area is on the barblets of the catfish, but on the filiform pelvic fins of the gadoids, particularly the smaller forms, like the hake and tom cod. Correlated with this difference is a striking difference in the course of the secondary gustatory tracts for nerves coming from the cutaneous taste buds. In the catfish the facial gustatory center has migrated forward for ease of correlation with the tactile and motor centers of the barblets, jaws, etc., and there is a broad connection between this facial lobe and the general tactile center in the funicular nuclei, whence a common motor reflex path serves to put both sense organs into relations with the motor centers. In the cod there has been no forward migration of the facial lobe, because the tactile nerves from the most sensitive area come in behind the vagal lobes by way of the spinal nerves. And the secondary gustatory path from the terminal nucleus of the cutaneous taste buds does not connect with the tactile correlation center, but passes directly to the motor centers. This short-circuiting of the reflex path from cutaneous taste buds is

also an adaptation to the different and more active movements made by the cod in feeding.

C. JUDSON HERRICK,
Secretary

(To be continued)

SCIENTIFIC BOOKS

Second Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum. ANDREW BALFOUR, M.D., etc., Director. Department of Education, Sudan Government, Khartoum 1906. Royal 8vo. 255 pp., 21 plates, 106 figures.

The functions of the Wellcome Research Laboratories founded by private munificence are thus expressed in the language of the foundation:

(*a*) To promote technical education; (*b*) to promote the study, bacteriologically and physiologically, of tropical disorders, especially the infective diseases of both man and beast peculiar to the Sudan, and to render assistance to the officers of health, and to the clinics of the civil and military hospitals; (*c*) to aid experimental investigations in poisoning cases by the detection and experimental determination of toxic agents, particularly the obscure potent substances employed by the natives; (*d*) to carry out such chemical and bacteriological tests in connection with water, food stuffs, and health and sanitary matters as may be found desirable; (*e*) to promote the study of disorders and pests which attack food and textile producing and other economic plant life in the Sudan; (*f*) to undertake the testing and assaying of agricultural, mineral, and other substances of practical interest in the industrial development of the Sudan.

The first report of these laboratories covered the history of its work up to January, 1904; the second, now before us, brings the record down to the early part of 1906. The director, Dr. Andrew Balfour, assisted by a staff of five or six scientists, has achieved a piece of work that from every standpoint deserves the highest praise. The difficulties of scientific work in a region so far removed from supplies and necessities, to say nothing of conveniences, one where "native helpers have proved to be only broken reeds," "not to be trusted beyond the bottle washing stage," can not easily be over-estimated. Despite this the field covered both in territory and in topics investigated, is so broad and the results presented in the report so extensive, that only the most important can be noted here.

F. V. Theobald, the consulting entomologist, has written a fine chapter on the mosquitoes, as well as others on human, animal and vegetal pests. E. E. Austen, of the British Museum, London, has contributed also a valuable chapter on blood-sucking diptera from the Anglo-Egyptian Sudan.

The work reported by the director himself is full of interest. It begins with a record of mosquito work in Khartoum and the Anglo-Egyptian Sudan. By the persistent work of the mosquito brigade anophelines have been practically abolished and the town kept in a fairly satisfactory condition, one vastly different from that which used to obtain. "At Khartoum the subject is complicated by the presence of mosquito-carrying steamers, boats and barges. Were it not for these, success would have crowned the efforts at extinction." For about $350 in 1905 Khartoum was kept free from malaria, and to a very large extent also from the annoyance which usually adds so much to the discomforts of life in the tropics; a trivial expense for such immunity.

Of other biting insects the distribution of *Glossina morsitans,* the carrier of trypanosomiasis in animals has been found to be somewhat general in the southern Sudan, and *G. palpalis,* the vector of the human trypanosome, has been positively identified from the extreme southern limits of the country. Valuable data are given on the habits of other biting insects, including the Congo floor maggot, and the true jigger, or Chigoe, not heretofore reported from the Sudan. Some records of ticks and an extended discussion of *Aphis sorghi* and of locust swarms, and their destructive work as well as of their parasites, are worthy of note.

A hæmogregarine from the jerboa, or desert rat, which was the first to be found in mammals, is described in detail and well illustrated. It is similar to one since reported by Captain Christophers in India. The free motile stage was observed only three times, but