After all the observations had been thus reduced the systematic difference between the "Cordoba General Catalogue" and the "Cape Catalogue" of 1850 was applied as the mean epochs of the Cape, and the Washington observations are approximately the same.

A comparison with a manuscript copy of a catalogue of the mural zones prepared by Dr. E. S. Holden and furnished the observatory through the courtesy of Dr. Holden and Professor W. W. Campbell, while disclosing a number of differences in identification, has led to only nine changes in the 8,744 observations so far compared.

A preliminary discussion of the catalogue positions gives the following mean differences between two observations.

MEAN DIFFERENCE BETWEEN TWO OBSERVATIONS IN RIGHT ASCENSION

Instrument	1846–1849 (Eye and Ear)				1851–1852 (Chronograph)	
	Number of Differences	Two Threads in Each Observation	Number of Differences	Three Threads in Each Observation	Number of Differences	Five Threads in Each Observation
		s		s		s
Mural circle	246	0.20	172	0.16	150	0.09
Transit instrument.	334	0.17	70	0.15	394	0.11
Meridian circle.....	224	0.22	213	0.18	286	0.15

MEAN DIFFERENCE BETWEEN TWO OBSERVATIONS IN DECLINATION

Instrument	1846–1849		1851–1852	
	Number of Differences	Mean Difference	Number of Difference	Mean Differences
Mural circle	407	1.″5	142	2.″1
Transit instrument.	206	2.8	331	2.5
Meridian circle.....	394	2.5	244	1.9

At the present time over one half of the printer's copy of the catalogue is completed. As fast as the copy is finished one set of the results is being sent to Dr. A. Auwers, of Berlin, for insertion in the "Geschichte des Fixsternhimmels." The entire catalogue will be ready for the printer in two or three months.

W. S. Eichelberger

January, 1910

THE AMERICAN SOCIETY OF ZOOLOGISTS EASTERN BRANCH

The Eastern Branch of the American Society of Zoologists met at the Harvard Medical School, Boston, Mass., on December 28, 29 and 30, 1909.

The following resolution was adopted:

Resolved (1) That the Eastern Branch of the American Society of Zoologists express its gratitude for the work of the Commission on Nomenclature of the International Zoological Congress.

(2) That it is the sense of the society that the commission be encouraged to extend its present work of deciding questions as to particular specific and generic names.

(3) That it is the sense of the society that the commission should of its own motion extend its jurisdiction to the ruling in or out of particular works of disputed status, like the Museum Bolteneanum.

(4) That in rendering decisions the commission have power to disregard the priority rule for sufficient and specified equitable reasons.

(5) That all members of this society should submit their questions of nomenclature to the international commission and abide by its decisions.

The president of the society, Professor H. S. Jennings, Johns Hopkins University, and Professor E. L. Mark, Harvard University, were appointed to act as delegates of the society at the eighth International Zoological Congress.

Officers were elected as follows:

President—Thomas H. Montgomery, Jr., University of Pennsylvania.

Vice-president—Harris H. Wilder, Smith College.

Secretary-treasurer—Herbert W. Rand, Harvard University.

Member of Executive Committee—David H. Tennent, Bryn Mawr College.

The following papers were presented:

The Segmentation of the Salpa Stolon, with some Reflections on Segmentation Generally: W. E. Ritter, University of California.

Some Problems of Cœlenterate Ontogeny: Chas. W. Hargitt, Syracuse University.

The paper briefly reviews certain facts of hydroid development brought to the attention of the society on previous occasions, and cites additional facts and observations which confirm the earlier results. Of the latter may be cited those found

to occur in the development of *Pennaria australis*, a hydroid having much in common with the local species, and corroborating its phases of development in a very remarkable degree. It may be added that these facts taken with those already known as to the perfect development of polyps from even the most erratic early cleavage leave no further room to doubt the perfectly normal character of the phenomena described.

Facts in the development of *Clava*, *Hydractinia* and *Tubularia* were also cited as confirming the previous conclusions, and thus further extending the peculiar behavior under consideration.

Associated with the above were certain inferences and reflections of considerable theoretical significance. Attention was directed especially to facts of histogenesis. It was shown that much of earlier speculation concerning this feature was tinctured with error. Later facts of hydrozoan ontogeny have not afforded any clear support of these earlier speculative contentions. Special emphasis was placed upon the fact that histogenesis in cœlenterate ontogeny is of small homological value and apparently wholly devoid of phylogenetic significance. In fact, the processes involved in the formation of the germ layers are primarily physiological and not morphological. Both ectoderm and entoderm arise thus; the first for protective and locomotor ends, the second for digestive purposes and through specific digestive or nutritive processes in the morula or planula.

The detailed paper will appear later in the *Journal of Morphology*.

Development of the Paraphysis and Hypophysis in the Alligator: A. M. REESE, West Virginia University. (Presented by title.)

The paper will be published in full in the "Smithsonian Miscellaneous Collections."

The Independent Origin and Self-differentiation of the Lens of the Eye: CHARLES R. STOCKARD, Cornell Medical School.

Normally the embryonic optic vesicle comes in contact with the lateral ectoderm of the head and this ectoderm responds to the presence of the vesicle by proliferating a mass of cells which develop into the crystalline lens. The question arises whether the ectoderm may form a lens even though the optic vesicle fails to come in contact with it, and further, what influence does the optic vesicle or cup exert over the subsequent development of the lens? The problem is more complex than it would seem at first sight and involves principles similar to those expressed in the correlation between the development of certain secondary parts and the internal secretions formed by organs on which these parts appear to depend.

By artificially suppressing and retarding the development of the optic vesicles in fish embryos I have obtained exceptional material for the study of the lens problem and from such embryos the following conclusions may be drawn.

A crystalline lens may originate from the ectoderm without any direct stimulus from either the optic vesicle or the brain tissue. The independent lens-bud is capable of perfect self-differentiation and finally becomes a refractive body identically similar in histological structure to a normal lens within the eye. The size and shape of a lens are not entirely controlled by the associated optic cup.

An optic vesicle, whether normal or defective, is invariably capable at some stage of its development of stimulating the formation of a lens from ectoderm with which it comes in contact. This ectoderm may even be out of the usual lens-forming region. Ectoderm of the head region, however, is more disposed to the formation of lenses than that of other parts of the body, as is indicated by the fact that the free lenses invariably occurred in this region.

In *Fundulus* embryos the deeply buried optic vesicles are unable to form lenses from their own tissues, although this is not true in all animals.

Further Data Concerning Twins: H. H. WILDER, Smith College.

The distinction formerly made between the two biological types of twins was reiterated, viz., duplicates and fraternals, the one presumably from the division of a single egg, after fertilization; the other from two separate eggs. Outline tracings of palms and soles of numerous individuals were presented for examination and comparison. These showed (1) that in twins of the duplicate type the main features in the configuration of the palmar and plantar epidermic ridges (friction ridges) are practically identical, and always in the case of all four sets of members; (2) that in twins of the fraternal type these features are as unlike as in any two children of one family but of different birth; and (3) that although single hands or single feet, or perhaps both hands or both feet, of two children of separate birth, especially in a large family, might be found to be as nearly alike as in cases of duplicate twins, this similarity does not extend to all four sets of chiridia, as always in these latter cases. Tracings of four sets of duplicate twins, of four

sets of fraternal twins, and of two sets of similar children of separate birth, were shown in support of the theory as stated.

Manufacture of the Squid Spermatophore: G. A. Drew, University of Maine.

Developmental Changes in Egg Substances: Edwin G. Conklin, Princeton University.

In normal, living eggs of *Physa, Limnæa* and *Planorbis* two ooplasmic substances may be recognized, a milky or clear-gray substance, which comes to the surface of the egg at the animal pole at the time of the first maturation and which then gradually spreads over the upper hemisphere, and a yellow yolk-laden substance which is uniformly distributed through the egg before maturation, but is confined to the vegetative hemisphere after both maturation divisions. During the cleavage the clear-gray substance goes into the three quartets of ectomeres, the yellow material into the entomeres and mesomeres.

When centrifuged with a force equal to 600 times gravity for from five to twenty minutes these substances stratify in three zones, a gray zone of light substance at the central pole, a yellow zone of heavy substance at the distal pole, and a zone of clear substance, containing the nucleus, between these two.

When centrifuged before the first maturation division the proportions of these three substances are, gray one eighth, clear three eighths, yellow one half. Centrifuged just before the first cleavage, the gray and clear substances are not distinctly separated and the proportions are, gray and clear seven eighths, yellow one eighth.

Before the first maturation the centrifuged eggs orient rapidly with the yellow pole down and the gray pole up; after the maturation divisions these same eggs orient very slowly, though the gray and yellow substances remain distinct. Also eggs centrifuged after the maturation divisions orient very slowly.

Before the first maturation the gray and clear substances are finely granular, without the appearance of vacuoles or spherules, and the yellow material is coarsely granular and contains yolk spherules. After the maturation divisions the gray and clear substances contain vacuoles or spherules, and the yellow is apparently less spherular than in the earlier period.

Some of these changes may be due to the increased viscosity of the ooplasm in the later stage as compared with the earlier one, though this is not the only factor involved, since the stratification is less complete in later stages even when greater centrifugal force is used. In probably all cases there is a redistribution, to a certain extent, of the stratified substances during mitosis, but this is never complete, and the original planes of stratification may be observed for a long time during the development.

All eggs centrifuged before the first maturation division develop normally; centrifuged during the maturation divisions about one half develop normally, and one half abnormally; centrifuged at the time of the first cleavage, or just before, almost all develop abnormally. There is no evidence that this result is due to greater injury to the mitotic figure in the later stages than in the earlier ones. Embryos, otherwise entirely normal, may be produced in which the yellow and gray substances may be distributed in any axis, and even where the distribution of all the substances to the cleavage cells is abnormal and unsymmetrical, normal development may result.

Neither the yellow nor the gray substances are formative, and neither are indispensable to development. They may be distributed to the first four cells in varying proportions and yet the resulting development may be perfectly normal; either may even be thrown entirely out of the egg and yet the remainder may develop into a normal snail. The gray substance is largely of a fatty nature, the yellow contains yolk, and both may be regarded as "inclusions" in the protoplasm. On the other hand, the clear substance is indispensable to development, though it may be formed anew in cells which lack it if a nucleus is present, and this clear substance in turn contributes to the growth of the nucleus, whereas the other substances do not. Finally, the clear substance alone, of all the ooplasmic substances, increases in quantity during development. It is therefore true protoplasm. Nevertheless, normal development may result from eggs in which this substance is abnormally distributed as regards both polarity and symmetry, and in this respect it does not correspond to the "ground substance" of Lillie.

The Fertilization Membrane of Nereis: Frank R. Lillie, University of Chicago.

In the unfertilized egg of the *Heteronereis* found swarming at the surface of the water on moonless summer evenings at Woods Hole, there occurs a layer of coarsely alveolar protoplasm between the vitelline membrane and the yolk-bearing protoplasm. This layer, which is 6–7 μ in thickness and entirely devoid of yolk, has been called the

zona radiata by Wilson. The perivitelline space arises by the extrusion of the homogeneous contents of the alveoli of this layer through the vitelline membrane into the sea water, where it forms by swelling a layer of jelly, which may be as much as 100 μ in diameter. The walls of the alveoli remain and form a protoplasmic lining of the vitelline membrane and exceedingly delicate strands of protoplasm crossing the perivitelline space. The perivitelline space is, therefore, *intraovular*.

The fact that the egg of *Nereis* thus secretes its own jelly may readily be demonstrated by fertilizing under the microscope with excess of sperm. If excess of sperm be added to closely placed eggs and a cover glass applied so as to force the eggs into a single layer, and the preparation examined with no loss of time, the spermatozoa will be seen in large numbers in immediate contact with the vitelline membrane. In one or two minutes the spermatozoa are moved away from the surface of the eggs by some invisible repelling substance, and they unite in lines that form hexagonal areas, with an egg in the center of each. The substance that sweeps the spermatozoa away from the eggs is the jelly, and synchronously with its formation the cortical layer disappears, leaving the perivitelline space crossed by protoplasmic strands as already noted.

In the case of each egg a single spermatozoon remains attached to the vitelline membrane. But this spermatozoon requires about twenty-five minutes to penetrate completely through the membrane. The stimulus to development thus precedes penetration by a considerable interval of time.

Unfertilized eggs retain the cortical layer and form no jelly, but if they are centrifuged or sufficiently stimulated with KCl the jelly forms, the perivitelline space arises and maturation takes place. KCl eggs may then differentiate further, but without cleavage.

It would appear, then, that any condition that so alters the permeability of the vitelline membrane as to permit the outflow of the alveolar contents of the cortical layer initiates development, but that the normal continuation of development is dependent on other factors.

Factors which Influence the Maturation of the Egg and Ovulation in the Domestic Cat: W. H. LONGLEY, Yale University. (Introduced by W. R. Coe.)

The course of maturation and ovulation in cats which have paired has been briefly sketched by R. Van der Stricht[1] in a preliminary paper. He finds correctly that two polar bodies are formed, the first in the ovary, and the second in the Fallopian tube, but does not note, as the case is, that the formation of the second is conditioned by the entrance of the sperm head into the egg.

The conclusions herein arrived at depend largely upon data derived from animals not allowed to pair.

Tube eggs before fertilization or in early phases of that process, that is, just after leaving the ovary, are approximate spheres. Each has a thick, tolerably uniform zona with no leucocytes or granulosa cells within it. The corona of each is highly radiate.

The study of the recently ruptured follicle shows that its epithelial lining is always very thin and the follicle just before rupture shows a high cumulus containing lacunæ.

These criteria exclude from the class of normal eggs all such as are found undergoing maturation in the ovaries of animals sexually immature, or in mature animals at the beginning of heat, or at any time during heat, if pairing does not occur. In so far, therefore, as it anticipates normal development, the maturation of the cat's egg is dependent upon pairing.

Of ten animals killed at periods ranging from 23 to 50 hours after pairing, six had already ovulated, and the one killed at 23 hours would surely have done so within the longer time mentioned. In a second series of five animals not allowed to pair, individuals were killed at 56, 73, 74 and 144 hours after first being noted to be willing to pair. None of these had ovulated, as opposed to the 70 per cent. of the first series. Still another was killed one week after the close of a period of heat of at least six days. This animal likewise had not ovulated.

The ovaries of the animal last mentioned showed three distinct series of degenerating eggs, which would easily bear the interpretation that they represented groups which had successively come to the point where they awaited the stimulus of pairing to bring about their discharge, but failing to receive it, had degenerated.

Thus in spite of the fact that Bonnet[2] has recorded a tube egg in an animal which he be-

[1] "Vitellogènese dans l'ovule de la chatte," *Ann. de la Soc. d. Med. d. Gand.*, 1908.

[2] "Beiträge zur Embryologie des Hundes," *Anat. Hefte*, Bd. IX., 1897.

lieved had been confined beyond the possibility of impregnation, from the evidence presented it would appear that ovulation in this animal, as well as in the rabbit (Heape[3]) and ferret (Marshall[4]), is strictly dependent upon pairing.

Early Maturation Phenomena in the Primary Oocyte of Sabellaria vulgaris (Verrill): H. E. Jordan, University of Virginia. (Presented by title.)

Only ovarian and free cœlomic eggs have been studied. The material was collected at Cold Spring Harbor, L. I. The youngest oocyte, almost wholly nucleus, has a diameter of 4 microns. The diameter of the full-grown egg varies from 50 to 60 microns. Maturation proceeds to the metaphase of the first polar spindle in the ovary, after which a pause ensues until fertilization. The youngest oocytes are in synizesis. The intensely chromatic spireme is distinctly polarized. The spireme segments into a large number of V-shaped chromosomes. The shape and manner of formation of the latter suggests telosynapsis.

The chromosomes persist in various shapes through the entire growth period. The chromosomes, as arranged on the spindle, are very small and slender. As many as forty have been counted in three consecutive sections, but this may represent a second count of several. Occasionally, the chromosomes are massed close to the nucleolus before their entrance into the spindle. The spatial relationship between the chromosomes and the nucleolus appears less intimate than in several forms studied, *e. g.*, *Asterias* and *Cumingia*.

Both nucleolus and centrosomes disappear at metaphase. The cytoreticulum is coarse and its meshes are filled with spheric yolk granules. The astral rays are clearly continuous with the cytoreticulum. The evidence here favors a spongioplastic origin of the amphiaster.

The Relation of Nucleoli to Chromosomes in the Egg of Cribrella sanguineolenta (Lütken): H. E. Jordan, University of Virginia. (Presented by title.)

The material for this study was collected at South Harpswell, Me. The full-grown ovarian egg is very large. It has an alveolar cytoplasm, and its large eccentric nucleus (diameter 300 microns) contains very numerous chromatic nucleoli of graded sizes. Occasionally it may also contain an additional very large nucleolus, the remains of the originally single nucleolus. Scattered among the nucleoli, and frequently in intimate contact with them, are a number of beaded chromatic threads of varying length, the chromosomes. The nuclear appearance suggests an amphibian egg.

The single nucleolus of the earliest stage gives origin to secondary nucleoli, apparently by a process of extrusion. These in turn produce still smaller nucleoli by a similar process. The final products of nucleolar budding are approximately equal in size to the granules of the chromosomes. The evidence indicates that the chromosomes are formed of the final products of nucleolar dispersion. The chromosomes arise from the original nucleolus or its products, at least to the extent that their chromatin content is supplied by them.

An interesting generic difference in the manner of the formation of the nucleoli obtains between *Echinaster* and *Cribrella*. In the former the single nucleolus fragments into secondary formations; in the latter the nucleolus extrudes secondary nucleoli. In the former again, the products are usually four-lobed; in the latter spheric. In an earlier study of *Echinaster* I was inclined to interpret these quadripartite bodies as chromosomes or possibly their constituent elements. In the light of facts derived from a study of *Cribrella*, it seems more probable that the several beaded chromatic threads found in *Echinaster* are also there the chromosomes. This, however, does not invalidate the conclusion that in the last analysis the chromosomes arise from the nucleolus. The four-lobed bodies more probably represent a peculiar stage in the process of nucleolar budding preparatory to chromosome formation as in *Cribrella*.

Dimegaly of the Sperm Cells of Euschistus: T. H. Montgomery, Jr., University of Pennsylvania.

Experiments on the Effect of Conjugation on the Life History in Paramecium: H. S. Jennings, Johns Hopkins University.

Pairs that were beginning conjugation were isolated, in some cases separating the individuals before conjugation was consummated, in others allowing conjugation to occur. Both sets were then kept under identical conditions, and their reproductive powers and vitality observed. Comparison of about two hundred of those that had been allowed to conjugate and of those that had

[3] "Ovulation and Degeneration of Ova in Rabbits," *Proc. Roy. Soc. Lond.*, Vol. 76B, 1905.

[4] "The Œstrous Cycle in the Common Ferret," *Quart. Jour. Mic. Sci.*, Vol. 48, 1904–05.

not showed: (*a*) Those that had conjugated divided less rapidly for about a month, when the difference became equalized. In no case did those that had conjugated show a more rapid rate of fission, even after more than a month. (*b*) Many of those that had conjugated did not divide at all, or divided but once or twice in an abnormal way, then died. All those that had not been permitted to conjugate lived and divided normally. (*c*) Among those that had conjugated many abnormalities and monstrosities occurred, while none occurred among those not permitted to conjugate. Thus the experiments gave no indication of a rejuvenating effect of conjugation. It was suggested that conjugation might be preliminary to a resting condition, in which unfavorable environmental conditions are tided over.

Effect of External Agents upon Growth in Paramecium: A. H. ESTABROOK, Johns Hopkins University. (Introduced by H. S. Jennings.)

Examination was made of the growth of *Paramecium* in pure distilled water, and in solutions of sodium chloride, nicotine, strychnine nitrate and alcohol, the results being compared with the growth in hay infusion.

It was found that the cell after fission has a strong tendency to grow in a perfectly definite way, at a definite rate, the growth giving a definite curve. It thus grows in spite of the absence of any food materials; in spite of the almost complete absence of the usual salts in the water, and in spite of the presence of actively injurious chemicals that later kill the organism. Evidently inner conditions give the animal a potential of growth which it is difficult to overcome.

No evidence was found that by subjection to chemicals a race of a given type can be transformed into a larger or smaller race.

Does Lecithin Influence Growth? A. J. GOLDFARB. (Introduced by T. H. Morgan, Columbia University.)

After referring to the chemical nature of lecithin, the speaker pointed out the rôle of lecithin in the living cell. The evidence was then reviewed upon which the generally accepted view is based that lecithin exerts a marked acceleration upon the growth of an animal.

The speaker then described his own experiments upon the same kind of animals as those used by previous investigators. Emphasis was laid upon the following: (1) the greatest pains had been taken to free the lecithin from impurities; (2) variations due to environmental factors were reduced to a minimum; (3) the large number of animals used rendered it practically certain that the resulting data did not represent individual variations; (4) the degree of variation for each kind of animal was ascertained by comparing the controls for each series and litter; (5) animals given lecithin in doses ranging from subminimal to injurious showed no definite corresponding increased growth. The utmost irregularity prevailed. Approximately one half the animals grew faster, one half slower than the respective controls. The gain was well within the normal variation.

Regardless of the kind or dose of lecithin used, or the manner of administering it, lecithin did not accelerate the growth of animals.

Is the Stimulation toward Artificial Parthenogenesis a Physical or a Chemical Process? J. F. MCCLENDON, Cornell Medical School.

I caused artificial parthenogenesis in the eggs of *Arabacia punctulata* by the following agents which stimulate muscle and produce hæmolysis: isotonic NaCl, and the following chemicals and conditions in sea water: acids, alkalis, hypertonicity, hypotonicity, ether, diminished oxygen, KCN, heat, cold, induction shocks and mechanical agitation. All of these methods probably increased the permeability of the eggs, causing a disappearance of the positive charge on the surface and thus increasing the surface tension. A band of greatest surface tension around the egg would cause cleavage, contrary to Robertson, whose experiment was vitiated by the fact that the oil drop used as a model was floating on water. I found that just before cleavage the pigment plastids migrated to the egg surface, which, if they were charged negatively, would result from the potential gradient produced at the moment the egg surface became more permeable. The fact that CO_2 and catalase come out of the egg and oxygen enters the egg, in increased amount about the time of cleavage, indicates increased permeability. The substances increasing, the permeability may enter the egg later, although their specific action was on the surface. The fact that rise in temperature causes parthenogenesis invalidates Loeb's deductions from the temperature coefficient, and the factor common to fertilization and artificial parthenogenesis is probably physical, *i. e.*, increased permeability.

The Biological Cycle of the Hay Infusion: LORANDE LOSS WOODRUFF and MORRIS S. FINE, Yale University.

The data derived from the continuous study, by means of daily counts, of the organisms of a series of hay infusions made by three standard methods were summarized. The following general observations were made:

1. The distribution of the organisms, broadly speaking, is successively at the middle, top, middle and bottom of the infusion. The distribution is determined primarily by the supply of food and oxygen.

2. The so-called cycle of organisms and their distribution is not due to inherent changes in the potentiality of division of the organisms, but to progressive changes in the environment, *i. e.*, the "cycle" is in the medium and not in protoplasmic changes of the organism.

3. Many species of infusoria do not resort to conjugation to sustain rapid cell division when the environment is slowly changing, but encyst and remain at the bottom when the conditions become somewhat unfavorable. Epidemics of conjugation usually occur when the environment is rapidly changing. Data suggest that conjugation may be a means of surviving acute changes in the environment which, for example, preclude encystment.

The fauna and flora of the infusions were studied by L. L. Woodruff and the chemical changes by M. S. Fine.

The Converse Relation between Ciliary and Neuro-muscular Movements: Alfred G. Mayer, Carnegie Institution of Washington.

Among the cations of sea water, sodium is the most potent inhibitor of ciliary activity, and the most powerful neuro-muscular stimulant.

On the other hand, magnesium is the most potent in maintaining ciliary movement, and the most powerful inhibitor for neuro-muscular movements.

Potassium in weak concentrations, such as is found in sea water, is a primary depressant for cilia, but afterwards ciliary action recovers in its presence. For neuro-muscular movements, however, it is at first a stimulant and finally a depressant.

Calcium is a weak stimulant for ciliary movement, but a depressant for neuro-muscular activity.

Ammonium at first stops and finally permits of recovery of ciliary movement, but it at first stimulates and afterwards inhibits neuro-muscular movements.

Weak concentrations of acids (H ion) at first depress and afterwards permit recovery of ciliary movement, but they at first stimulate and afterwards depress neuro-muscular movements.

In each case the effect of the salt is exerted through its cation.

We may present these results in a graphic manner if we represent a stimulus by a + sign, and an inhibition of movement by a — sign, the greater the effect the larger the print. Successive effects may be represented by a succession of signs; thus: —+ means a depression followed by recovery of movement and +— an initial stimulus followed by depression. Bearing this preamble in mind, the following table will illustrate the effects of the various cations:

Cations	Effect upon Neuro-muscular Movement	Effect upon Movement of Cilia of Animals
Sodium	+	—
Magnesium	—	+
Potassium	+—	—+
Calcium	—	+
Ammonium	+—	—+
Hydrogen	+—	—+
Lithium	+	—

Ringer's solutions, which consist of sodium, potassium and calcium chlorides, are powerful initial stimulants but finally produce depression of movement and muscular tetanus. This deleterious effect can, however, be overcome by adding magnesium, although this destroys the stimulating influence of the solution.

My experiments suggest that in surgical operations involving considerable loss of blood the Ringer's solution, which it is the practise to inject into the blood system to stimulate the heart, should be followed after recovery from the shock of the operation by a solution containing the amounts and proportions of sodium, potassium, calcium and *magnesium* found in the blood, thus counteracting the injurious after-effects of the Ringer's solution.

The Summation of Stimuli in Invertebrates: Frederic S. Lee, Columbia University, and Max Morse, College of the City of New York. (Introduced by R. C. Osburn.) The paper will be published in the *American Journal of Physiology.*

Summation of stimuli has been described in both plants and animals and is a wide-spread physiological phenomenon. It is usually ascribed

to an increase in irritability, such that a stimulus that is too weak to cause a response when applied singly, will, upon repetition, prove effective. The observations here reported were made on the muscles of certain species of invertebrates, namely, *Cyanea arctica, Aurelia flavidula, Homarus americanus, Carcinus mœnas, Cancer irroratus* and *Cancer borealis*. The major part of the work was done on *Cyanea arctica, Carcinus mœnas* and *Homarus americanus*, the muscles of all of which possess a marked power of summating stimuli. It was found that the irritability of the muscles can be raised by the administration to them of carbon dioxide or lactic acid in great dilution. Solutions of lactic acid of from 1/100 gram molecular to 1/6400 gm. were used, the best results being obtained by the use of 1/1600 gm. It was found possible by these reagents to change the threshold of stimulation so that a muscle responded by contractions to shocks from an inductorium which previously were unable to elicit responses. Thus by the injection in small quantities of agents which in larger quantities depress the action of muscle, it is possible to enable the muscle to respond to stimuli previously ineffective. Gotschlich found that subminimal stimulation of muscle renders it acid in reaction, even though no contractions occur. The conclusion, therefore, seems to be justified that summation of stimuli is due to a rise in irritability, brought about by the action on the living substance of small quantities of certain products of metabolism, especially carbon dioxide and lactic acid, the same substances which in larger quantities are important factors in fatigue.

Rates of Regeneration in Various Salt Solutions, and the Influence of Regenerating Tissue on the Animal Body: CHARLES R. STOCKARD, Cornell Medical School.

The processes of regenerative growth in the salamander are favorably affected by weak doses of KCl while $CaCl_2$ inhibits the rate of growth and differentiation of the part. Solutions of $MgCl_2$ also inhibit growth and differentiation, yet not so decidedly as the $CaCl_2$. Mixtures of half doses of $CaCl_2$ and $MgCl_2$ do not influence either growth rate or differentiation.

The influence of a salt solution is largely dependent upon the salt to which the animal has been previously subjected, even though some time may have elapsed since the former treatment was applied. Animals that have regenerated at a fair rate in solutions of KCl are less depressed by treatment with $CaCl_2$ than others which have not been treated with KCl.

When animals are unfed they decrease in body size. This decrease is greater in regenerating individuals, and the larger the amount of tissue an individual is regenerating the more rapidly does it decrease in size. The new regenerating tissue grows at a vigorous rate on account of its excessive capacity for the appropriation of nutriment from the old body tissues, and it is this fact that causes the body to decrease in size and become weak and emaciated. A closely similar action is seen in the behavior of certain malignant growths.

On the Structure and Regeneration of the Epidermal Layer in some Siliceous Sponges: H. V. WILSON, University of North Carolina. (Presented by title.)

The epidermal layer in two monactinellid sponges (*Stylotella* and *Reniera*) was studied. Various histological methods were employed. The epidermis does not consist of flat epithelium cells (pinacocytes), but is a continuous, thin sheet of protoplasm studded with nuclei and entirely without cell boundaries. It is a syncytium.

The pores are the superficial apertures of very short canals (pore-canals) which perforate the dermal membrane. Closure of the pore is brought about by an extension (pore-membrane) of the thin epidermal layer over the pore-canal. The pore-membrane in *Stylotella* from the start is continuous and diaphragm-like. In *Reniera* the pore-membrane in the early stages of pore-closure exhibits active, amœboid changes of shape and position.

In *Stylotella* a new epidermis develops over a cut surface in the course of a day. It is formed by the cells of the mesenchyme, which are already interconnected by slender processes. The mesenchyme cells crowd to the surface and flatten out. At this time they are close together and connected by a reticulum of delicate, protoplasmic strands. Union between the cells then becomes perfect, their boundaries disappearing.

Wound Reparation and Polarity in Tentacles of Sagartia: HERBERT W. RAND, Harvard University.

If a distal piece is cut from a tentacle of *Condylactis* or other large actinians, the wall at the cut edge of the stump immediately bends inward slightly. Then a broad zone of wall at the cut edge contracts until its lumen is obliterated, so that the distended stump, now functionally

closed, bears a conspicuous projecting cylindrical "nipple." Within two days the contracted zone gradually relaxes, the nipple disappears, and the end becomes structurally closed.

The relatively very small tentacles of *Sagartia luciæ* show similar behavior, but the structural closing is accomplished within six hours.

Sagartia was kept in a solution of chloretone such that all muscular activity was suspended during eight hours. The initial inbending at a distal cut edge nevertheless took place. But the zone of wall which ordinarily contracts to form the nipple did not contract; no nipple was formed. *A steady centripetal movement of uncontracted tissue at the cut edge occurred until within eight hours the cut end was structurally closed.*

The temporary nipple, therefore, results from muscular contraction, but the definitive closing depends upon non-muscular activities which effect a spatial readjustment of the tissues near the cut edge.

The regions of a tentacle which are proximal and distal with reference to a plane of cutting or the point of application of a tactile stimulus differ markedly in their immediate reactions to the cutting or the tactile stimulus. The form assumed by a proximal cut end is distinctly different from that of a distal cut end. In these respects the *Sagartia* tentacle tissues, like those of *Condylactis*, show a distinct polarity which is not explicable upon the basis of their known structure.

The Regulation of the Water Content in Regeneration: Sergius Morgulis, Harvard University. (Introduced by E. L. Mark.)

An examination of the water content at successive stages of regeneration in a polychæt, *Podarke obscura*, showed that the percentage of water rises rapidly soon after the operation, reaching a maximum between the first and second weeks, approximately at the time of highest regenerative activity; subsequently it begins to decline. In this respect (rise and fall of the percentage curve of water) regeneration is essentially like embryonic growth. But while in embryonic growth the increase of the percentage of water is due to imbibition of water from the surrounding medium, this, apparently, is not the case in regeneration.

The regenerating worms, whether fed or starved, are losing in weight, and three phases of regulation of the water content in the organism may be distinguished during the process. At first there is rapid loss in weight, but proportionally more dry substance than water is lost, the percentage of water rising. Then follows a period of rather slow diminution in weight, when practically no water is being lost, the content of water attaining its maximum. Lastly, comes a period during which proportionally more water than dry substance is being lost, the percentage of water thus declining.

The Behavior and Structure of a New Species of Gregarine: R. A. Budington, Oberlin College.

The form described occurs in the alimentary tract of the barnacle, *Balanus eburneus*. It is of the polycystid plan of structure, and is conspicuous for the rapidity and complexity of its movements. Prolonged progression in a straight line, flexures and torsion of the body, movements of the protomerite in all planes independently of the rest of the body, are specially noticeable. Disturbances in the environment of the animal during its progression do not seem to be accounted for on the basis of either Schewiakoff's secretion theory or Crawley's epicytic undulations.

The nucleus, both while living and when stained "intra-vitam" and after fixation, shows an average of about five very distinct karyosomes ("prochromosomes"). Bodies of precisely similar appearance and which react similarly to nuclear stains are present in the protomerite; and since the wall of separation between proto- and deutomerite is complete, the chromatin content of the former, though not contained within an organized nuclear wall, make it in certain ways essentially a separate cell.

The Function of the Ear in Cyclostomes: G. H. Parker, Harvard University. (Presented by title.)

Within recent years evidence has been brought forward to show that killifish, goldfish, squeteague and dogfish can hear. No tests have been made on cyclostomes. As their ears are the most primitive in all the vertebrates, they were tested for hearing. Ammocœtes will rest quietly on the padded bottom of a wooden aquarium. When the side of the aquarium is struck by a heavy, swinging pendulum, the fish usually responds by a winking movement of the oral hood and by curving the body. After the eighth nerves are cut, these responses are called forth only by a blow three or four times as strong as that necessary to stimulate the normal animal. When only one nerve is cut, the fish responds in a normal manner. These observations show that the cyclostomes are responsive to sound, not only through the skin, but also through the ear.

The Morphology of the Swim-bladder in Teleosts: HENRY C. TRACY, Brown University. (Introduced by A. D. Mead.) (Presented by title.)

The most important types of swim-bladders are, first, primitive swim-bladders with an open pneumatic duct and undifferentiated epithelial lining, and, second, the highly specialized type without duct but with the so-called "oval" on its dorsal wall.

Two exceptional types are probably to be considered transitional forms. One is the swim-bladder of the eel; the duct is enlarged into a capacious chamber, but its œsophageal connection is much reduced. The duct is lined with flat epithelium under which is a *rete mirabile.*

The other transitional type is found in toadfish (*Opsanus*) and a few other forms. It has lost its œsophageal connection, but is divided into an anterior and a posterior chamber by a transverse partition, through which is a round opening. The structure of the walls of the posterior chamber is like that of the duct of the eel. This chamber develops directly from the embryonic pneumatic duct.

From the posterior chamber of the swim-bladder of the toadfish the transition to the oval may be considered to have taken place by an approximation of the partition to the posterior wall of the organ. The red gland develops by a progressive differentiation of the epithelial lining.

Ciliation of the Palps of the Acephala: J. L. KELLOGG, Williams College.

The known function of the ciliated inner surfaces of the palps of bivalves is to transport food particles from gills to mouth; but they have been found also to possess the power of directing undesirable materials, such as mud, on to ciliated tracts that carry them out of the body.

The inner palp surfaces are found to possess four distinct currents: one across the folds to the mouth; a second in the opposite direction, on the ventral palp margin; a third set of tracts on the faces of the palp folds, from their ventral to their dorsal ends; and a fourth set, deep in the grooves between folds, from dorsal to ventral ends.

The function peculiar to each of these was fully determined during the past summer in several of the large forms of Puget Sound. That of the fourth set is especially interesting. These tracts are entirely covered when the animal is feeding. They are exposed by a peculiar movement of the folds when a large quantity of material is brought to the palps, as is the case in muddy water, the entire mass being led to tracts that convey it from the body. The fate of particles brought to the palps is determined not by their nature—whether suitable for food or not—but solely by their volume.

Parallel Development in Tropical Trematodes: H. S. PRATT, Haverford College.

The digenetic trematodes as well as other internal parasites have probably in their phyletic history followed somewhat different rules of descent from those of other animals. The fact that they live inside of other animals and have also a very complex life history must affect their phyletic development most profoundly, and in two ways: (1) The possibilities of migration are very much limited. (2) The environment of the parasites being extremely uniform and subject to relatively little variation there is a corresponding uniformity of structure in the parasites themselves. Thus we see that although there are several thousand species of digenetic trematodes in existence living in all parts of the world they are astonishingly alike in structure—so much so that until quite recently all of the thousand or more species of distomes were included in the single genus *Distomum.* The monogenetic trematodes, on the other hand, which are external parasites and have consequently a very much simpler life history and a much more varied environment show a much greater variety of structure, although they count fewer species.

These facts make it probable that where there are apparently related species of digenetic trematodes living in widely separated localities the fact that they possess the same or similar structural features does not necessarily indicate that there is a close genetic relationship between them. They have not necessarily inherited their peculiarities from a common ancestor even when they are so much alike that they are classified in the same genus. But they are undoubtedly in very many cases descended from different ancestors and have reached their present structural condition by traveling along parallel or converging lines of descent.

These facts are well illustrated by the several species of digenetic trematodes belonging or allied to the genus *Helicometra* which were found in certain fishes in the Gulf of Mexico at Tortugas, Florida, and also occur in the Mediterranean Sea. That the species of this peculiar genus are thus taken as an indication, not that they necessarily bear a close genetic relationship to one another,

but that similar or identical environmental conditions exist for them in these places, so that they have come to possess in the course of time a structure so similar that they are included in one and the same genus.

A New Rhabdocœle, Commensal with Modiolus plicatulus: Edwin Linton, Washington and Jefferson College. (Presented by title.)

In searching for rediæ in a lot of mussels at Woods Hole in July last a small worm .2 mm. in length was found by the writer which at first was taken to be a redia with numerous cercariæ already active within it. On subsequent dates others were found. They proved to be turbellarians belonging to the genus *Graffilla*.

The species is viviparous, at least in July and August.

All stages of development, from the germ cells in the ovary-vitellarium to active ciliated young with black eye specks, may be seen in the same adult worm. There is a singular lack of uniformity in the details of development, although the outcome as a rule is the development of a pair of young worms within the same egg-membrane.

The worms are active, but move for only a short distance before changing their direction. They tend to move away from the light.

Their distribution is dependent on local conditions. They were not found in mussels which grow on confined coves or marshy places. The best localities for finding them are those which are exposed only at very low tides and where there is rather free tidal movement.

The Inadequacy of the Law of Priority, with a Suggestion for Relief: J. S. Kingsley, Tufts College.

Characteristics of the Diverse Races of Paramecium: H. S. Jennings and Geo. T. Hargitt, Johns Hopkins University.

Jennings has described the existence of a number of diverse races in *Paramecium*, differing constantly in size. The junior author of the present paper undertook a cytological study of six of these races, in order to determine their relation to the supposed species, *Paramecium caudatum* and *Paramecium aurelia*. It was found that two sets of races could be distinguished, one set having two micronuclei, the other but one. The races with two micronuclei were all smaller than those with one. The larger races together thus correspond with what had before been described as *P. caudatum*, the smaller races with *P. aurelia*. The two differ also in the size, position and staining relations of the micronuclei, in ways that correspond to the descriptions of Hertwig and Maupas. But *in rare cases* specimens of the *caudatum* races have two micronuclei, those of *aurelia* races but one, thus confirming the observation of Calkins on this point. The races have remained constant in size in the laboratory for between two and three years. They differ from each other (even within the *aurelia* or *caudatum* group) not only morphologically, but physiologically, especially in their relation to conjugation. It has not thus far been possible to cause the members of one race to conjugate with those of another.

The Pearl Organs of American Minnows in their Relation to the Factors of Descent: Jacob Reighard, University of Michigan.

Pearl organs are horny, conical epidermal upgrowths which occur in males and are functional only during the short breeding season. Extensive observation of the breeding activities of many species has made known in detail the *whole utility* of these organs to the species. They serve chiefly to roughen the skin and enable the male to retain his hold of the female during the brief spawning act.

In form, size and distribution they afford characters by which even the species of a subgenus are easily separable. In general the spawning attitudes of males of different species are such as to bring their roughened surfaces into contact with the female and a Lamarckian or Darwinian interpretation of the origin and differentiation of the pearl organs is thus suggested. Since the number of spawning attitudes is far fewer than the specific distributions of the organs concerned, the one could not have arisen in correlation with the other. From this fact and others it is concluded that the origin and specific distribution of the pearl organs must have come about without reference to utility and through internal forces. Use differences are here superimposed on structural differences in such way that no specific correlation exists between the two.

The Causes that Determine the Fauna and Flora of the Small Islands of the New England Coast; a Study in Natural Selection: A. E. Verrill, Yale University.

Abnormal Individuals of Didinium nasutum and their Bearing on the Question of Natural Selection: S. O. Mast, Goucher College, Baltimore. (Presented by title.)

In large vessels containing cultures of *Didinium*

one occasionally finds specimens with two or three oral ends and several bands of cilia, but never any which are more abnormal. Each oral apparatus is functional in these creatures. I have seen specimens swallow three paramecia at a time. If they are isolated and kept in shallow dishes with plenty of paramecia they thrive and reproduce rapidly. Ordinarily normal specimens are cut off at each oral end and the original individuals remain as they were, but in some cases there is a tendency to form more complicated abnormalities due to incomplete fission.

Many of these are unable to swim and consequently lie on the bottom. If there are numerous paramecia and the water is shallow, they persist indefinitely, and many abnormal specimens are formed as well as normal ones. Under natural conditions, however, such specimens are at once eliminated, for they sink to the bottom while the paramecia on which they feed remain near the surface. Natural selection is thus seen to operate in preventing the perpetuation of these monsters.

Variation in Urosalpinx: H. E. WALTER, Brown University.

Over 50,000 shells of the oyster drill, *Urosalpinx cinereus,* which were collected at various times between 1898 and 1908 from various localities both on the Atlantic and Pacific coasts, were carefully measured and the variation, as shown by standard deviation, computed. So far as the statistical method is able to reveal, it is extremely doubtful whether or not this mollusk when introduced into a new habitat, as happened when they were accidentally transplanted with oysters to the Pacific coast from the Atlantic, exhibits greater variability than in its new habitat. The change of variability appearing in successive fortnights in shells in the same locality, as well as the change showing itself in the August shells of the same locality for successive years, is pronounced enough to indicate plainly the working of an ontogenetic variability independent of environmental modification, that is, a time factor as distinguished from a place factor. In consequence of this, it is practically impossible to collect homologous lots of these shells upon which the place (or environmental) factor may be accurately determined.

Some Results of a Study of the Inheritance of Barring in Poultry: R. PEARL and F. M. SURFACE, Maine Agricultural Experiment Station.

Certain results obtained by reciprocally crossing Barred Plymouth Rock and Cornish Indian Game fowls were described. It was shown that the barred plumage pattern is inherited in these hybrids in a sex-limited manner. The cross Barred Plymouth Rock ♂ × Cornish Indian Game ♀ gives all barred offspring, in both sexes. The reciprocal cross gives barred males and solid black females. It was shown that the degree or intensity of pigmentation (apart from pattern) is not inherited in these hybrids in the manner to be expected if there were a simple blending of the degrees of this character manifested in the parents. The complete paper will shortly be published elsewhere.

Ophiurans and "Jordan's Law": HUBERT LYMAN CLARK, Harvard University.

The study of a large collection of ophiurans from the North Pacific Ocean has shown that closely related species are often found occupying the same area. In several instances, a given species was taken two or more times, in the same trawling, with its nearest known ally. These facts are counter to that principle of the extreme importance of geographical isolation which has recently been formulated and designated as "Jordan's law." An illustration of a form of physiological isolation was offered, found among West Indian ophiurans, which suggests a possible reason why geographical isolation is relatively unimportant in the class.

On the Geographic Distribution of some Pelagic Organisms: H. B. BIGELOW, Harvard University.

The Distribution of Flies in Providence: G. F. SYKES, Brown University. (Introduced by H. E. Walter.)

During the summer of 1909 a series of investigations was begun in Providence, R. I., for the purpose of ascertaining the actual importance of the "house flies" as a factor in the spread of enteric diseases. The following results were obtained: (1) the fly nuisance is local; (2) the geographic distribution of pestiferous flies is determined by local sanitary conditions; (3) the seasonal distribution is conditioned by meteorological influences (temperature and sunshine); (4) over 99 per cent. of all the flies caught (in three kitchens) were *Musca domestica,* the remaining fractional per cent. were *Lucilia cæsar;* (5) the plotted curve for typhoid cases did not show a close relation to the fly curve, but did show a close parallel to the temperature curve; (6) the high-water mark for deaths from diarrhœa antedated that for the fly season by fully three weeks, and followed from one to two weeks after a noticeable

rise in temperature; (7) the geographical distribution of typhoid cases over the city was largely independent of areas known as "unsanitary" and as "fly centers."

The conclusions drawn from these results point toward a more fundamental factor than the house fly in the spread of enteric diseases. Furthermore, judging from the constant relationship which the temperature curve maintained through the experiment, it is not unnatural to suppose that therein lies the solution of the problem; but whether the influence of temperature is real or only apparent, direct or indirect, remains yet to be determined.

The Leaping of the Pacific Salmon: Henry B. Ward, University of Illinois.

Observations made, chiefly in southeastern Alaska, on the red and humpback salmon indicate that the fish do not choose a particular point of attack in endeavoring to surmount a fall. The height and length of the jump were very variable and on the whole there appeared to be a remarkable lack of accuracy as well as of definiteness in the movement. This apparent aimlessness of the leaping may be the result of a fairly precise response to definite stimuli in the water currents which in the small whirlpools below the falls are subject to constant and unexpected changes. When endeavoring to surmount the falls the fish sail through the air with body rigid and fins spread tense, while at the instant when the momentum of the jump is lost one notes a series of rapid and powerful vibrations of the tail; these are made regardless of the success of the jump or of the position of the fish in air or in water. If the fish reaches solid water at the crest of the fall, they insure the maintenance of the vantage thus gained.

The open water jumping is of a distinct type, since the body leaves the water sidewise instead of in a vertical position, the musculature is somewhat relaxed and the fins are partly folded backwards, while finally there is no movement of the tail at the close of the jump. The purpose of this jump is not clear.

Direction of Locomotion of the Starfish (Asterias forbesii): L. J. Cole, Yale University.

It was shown that in the absence of directive stimuli, although starfishes might move with any ray in advance, in a large number of trials it was most often the one lying next to the left of the madreporic plate which went ahead. This may perhaps then be considered the *physiological anterior* of the animal. Attention was called to the fact that in the bilateral echinoids, the spatangoids, it is similarly the ambulacral area to the left of the madreporite which is anterior.

Reactions of Echinoderms to Light: R. P. Cowles, Johns Hopkins University. (Presented by title.)

A review of the literature dealing with the reaction of starfishes to light shows there is a general belief that these animals depend for their responses to light upon the eye spots situated at the tips of the rays. Some authors even state that certain starfish do not react to light when these organs are removed.

While experimenting with the starfish, *Echinaster crassispina*, the writer found that the eye spots may be removed and that the creature may still react to differences in the intensity of the light. The tips of the rays of several echinasters were amputated and these starfish were then tested in a rectangular glass dish lined with dead black paper and filled with sea water. The dish was placed in a black-lined box with a single opening at one end through which bright daylight was allowed to enter. When a series of tests were made the starfish was placed in the dish, care being taken to vary the manner of handling and also to vary the position of the rays with reference to the source of light. In the majority of tests the echinasters moved to the lighter end of the dish, although the reaction was somewhat slower than with normal individuals.

Reactions of Amœba to Light: S. O. Mast, Goucher College, Baltimore.

If direct sunlight is flashed on an active specimen of *Amœba proteus* all movement stops immediately. The pseudopods remain just as they are, without contracting, until after the lapse of a few moments, when new ones are thrown out, usually at the posterior end. Then the old ones gradually disappear. This occurs in the blue of the solar spectrum nearly as definitely as in white light. Green is much less effective; violet, yellow and red have scarcely any effect.

When an amœba comes in contact with a well-defined area of light composed of rays perpendicular to the slide, it usually stops and proceeds in a different direction.

In a horizontal beam of direct sunlight they orient fairly accurately. Changing the direction of the rays produces a change of intensity on the surface, but this causes no apparent retardation in any pseudopods. Nor does difference in light

intensity on opposite sides of a pseudopod induce difference in rate of streaming so as to cause it to bend. Orientation is due to the inhibition of the formation of new pseudopods on the more highly illuminated side of the body of the amœbæ, not to any effect on those already formed.

Colored Lights of Equal Intensity for Biological Work: G. H. PARKER and E. C. DAY, Harvard University. (Presented by title.)

Colored light was produced by passing the light from a Nernst lamp through a solution of an appropriate aniline dye contained in a plate-glass cell and used as a screen. In this way blue, green, yellow and red lights of fair spectroscopic quality were obtained. The intensity of these lights was measured in terms of energy (heat) by means of a radiomicrometer which was accurate to within 2 per cent. The stronger lights were then reduced by being placed at such distances from the animals experimented upon that all lights were of equal intensity at the spot where the animals were. It was proposed to extend this method to spectral light.

Notes on the Behavior and Reactions of Amphioxus: L. HUSSAKOF. (Introduced by Bashford Dean, American Museum of Natural History.)

These experiments were carried on at the Naples station during last September. They dealt with the behavior of amphioxus and its reactions to light, heat, chemical and mechanical stimuli. In some reactions the Neapolitan species, *Branchiostoma lanceolatum*, behaves differently from the Bermuda form, *B. caribbæum*, notably in regard to heat. The former is adapted to a temperature ranging from 35° C. to —.5° C., while the latter (as shown by Parker) will survive only within the limits of 42° C. and 4° C.

The Movements of the Earthworm—A Study of a Neglected Factor: SERGIUS MORGULIS. (Introduced by G. H. Parker, Harvard University.)

While studying reflex reactions of the earthworm I have been impressed with the fact that the worm tends to move in a straight direction, and, once having assumed such a course, it maintains itself obstinately in the path. This simple observation was substantiated by special experiments where, with the aid of an apparatus constructed for this purpose, the anterior or posterior part of the worm was deflected either to the right or to the left from the straight course. By turning the tail to the right, for instance, the head would be caused to turn to the left, and *vice versa*. The position of the tail could be changed several times successively, first to the right, then to the left, etc., and the head would likewise change its position but in an opposite direction. The extent of the orientation reaction of the head was found to be directly proportional to the length of the posterior part of the worm deflected from the straight course; while the degree of deflection of the posterior part necessary to occasion a bending of the head in an opposite direction is inversely proportional to the length of this part. Depending upon the relative position of its tail, the earthworm responding to unilateral stimulation turns either towards or away from the stimulus until it has assumed a straight position, and then it begins creeping in that direction.

The Leucocyte Content of Milk: R. S. BREED, Allegheny College.

Studies upon the Nerve Cells of Invertebrates: W. M. SMALLWOOD and C. G. ROGERS, Syracuse University.

The nerve cells of all invertebrates so far examined, including representatives of more than twenty genera of molluscs, worms and crustacea, contain pigmented or unpigmented solid granules of various sizes.

The same nerve cells show also the presence of many vacuoles, containing a transparent liquid. These may be very abundant and are located principally in the outer zone of the cytoplasm.

The vacuoles represent granular deposits which are in process of transformation, so as to furnish energy for the work of the cells.

Excessive work upon the part of the cells, starvation, etc., serve to bring about the destruction of the granules, and their replacement by vacuoles. The granules may, therefore, be considered to be storage material which may be called upon at any time of special stress to furnish energy for the work of the cells.

Some Observations on the Behavior of the Beach Flea, Orchestia agilis: A. M. BANTA. (Introduced by C. B. Davenport, Carnegie Institution, Station for Experimental Evolution.)

When disturbed by lifting the eel grass the animals are largely negative to light. In a few minutes if prevented from concealing themselves they become positive and remain so if the intensity of light remains constant or is increased. If the intensity is materially decreased, however, the orchestias become *negative*. This is a most exceptional reaction. With most organisms, if there is a reversal of the light reaction with change in intensity, the negative reaction is to

the higher intensity and the positive to the lower intensity. When thus made negative to dim light *Orchestia* becomes again positive if exposed to strong light. Kept in dry air, the animals become negative. After retention in darkness they are positive. Placed in water they are negative.

A number of these reactions are of evident importance in the animal's daily movements. The reversal from positive to negative with decrease in illumination aids in directing the animal's movements in reentering the eel grass, as likewise does the negative reaction when becoming too dry. The animal's negativity when in water aids it in reaching shore when overtaken by the tide, the shore line serving as a dark region as compared with the equally illuminated expanse of water in all other directions.

On the Transition from Parthenogenesis to Gamogenesis in Aphids and Braconids: S. J. Hunter, University of Kansas.

Continuous experimental study since May, 1907, on the aphid, *Toxoptera graminum*, has brought out the following regarding the development of aphids as illustrated by this species:

Parthenogenetic forms appear during the spring, summer and early fall. These forms may be winged or wingless, the latter greatly predominating. The characters of each remain constant until about October 1, when, as first observed by Glenn in this laboratory, these parthenogenetic forms begin to produce intermediate forms varying in structure between the winged parthenogenetic form and true female on the one side and the wingless parthenogenetic form and true female on the other side. Within the bodies of these intermediate forms appear, in some live young, in others winter eggs, in still others both winter eggs and living young. All such intermediate forms, however, die without producing offspring or eggs, as do many of the apterous parthenogenetic individuals belonging to the sexual generation.

These intermediate forms seem to be parthenogenetic individuals affected by the stimuli which bring about the transition from parthenogenetic females to the true sexes. In some the reproductive organs are unmodified, in others they approach the true female type to a greater or less degree. These intermediate forms belong to the sexual generation and may be considered as an attempt toward the development of the sex individual. They play no part in the life of the insect.

The parent of these intermediate forms and of the true female may be either winged or wingless. The males have no intermediate forms and are uniformly the offspring of the wingless parthenogenetic females. One single parthenogenetic wingless individual has been observed to produce types of all the above described forms. The above intermediate forms together with the appearance of the true sexes occur only during October, November and December regardless of the conditions under which the various experimental stocks are kept throughout the year and without reference to the number of generations.

Young growing wheat has been the uniform food plant throughout the entire period of experimentation.

In the braconid, *Lysiphlebus tritici*, a parasite of *T. graminum*, gamogenesis occurs in nature. In one count of a thousand insects taken in the field 5 per cent. were males, in another 35 per cent. By isolation of virgin females in fourteen experiments all offspring were males, and in seven experiments 1 out of 26, 4 out of 27, 3 out of 17, 1 out of 22, 1 out of 18, 1 out of 12, 2 out of 27 were females, making a total for the twenty-one experiments of 339 males and 13 females. In an extensive series of subsequent experiments no females have appeared. Of these parthenogenetic forms it is worthy of note that 203 of the males had 15-jointed antennæ, 131 had 14-jointed antennæ and 5 had 16-jointed antennæ. Of the 13 females, 8 had 13-jointed antennæ and 5 had 12-jointed antennæ. Gamic females show the same conditions, but among gamic males no 16-jointed forms have been found. Polyembryony does not occur in this parasite.

Proliferation of Eyes in an Abnormal Tentacle of a New Species of Marine Gasteropod: F. N. Balch. (Introduced by G. H. Parker.)

In the unique specimen of *Onchidiopsis corys* sp. nov. the left tentacle is bifid, the internal, or mediad, member appearing nearly normal and bearing a normal eye. The external member is abnormal in size and shape, is folded backward, bears on the surface thus exposed (but morphologically mediad) a normal-appearing eye, and if folded forward into its true morphological position would be the mirror-image of the internal member. On sectioning, the bifid tentacle is seen to bear two encysted parasites, probably cercarian. The "eye" in the external member is seen to consist of a group of four eyes apparently proliferating one from another and constituting one series of three "generations," and another junior

series of two, the largest eye being common to both series. All these eyes are complete in all their parts (lens, retina, etc.), though differing greatly in size, development of optic nerve and degree of external abstriction. All are internally completely occluded except the least developed, which still connects by a lumen with its "parent" eye. The growth is orderly in that it secures (*a*) the same axial orientation, (*b*) the same polar orientation, (*c*) freedom from mutual interruption of vision, (*d*) nearly maximum compactness. No other possible arrangement secures all these. The mass of tissue in the group is greater than in the normal eye. The case is unique in the literature. The possibility that it represents not proliferation but unequal development of the fragments of a broken-up *anlage* is admitted, but rejected as a probability. If a true case of repetitive proliferation of such specialized structures as these eyes, then near analogies are lacking.

The following exhibits were presented:

Inheritance of Color in the Common Clover Butterfly (Colias philodice): (a) 125 Descendants (F_1 and F_2) of a White Female. (b) Offspring of an Aberrant Female of the Spring Brood, resembling the Arctic Species (Colias nastes, Boisd.): J. H. GEROULD, Dartmouth College.

Cytological and Other Characteristics of the Diverse Races of Paramecium: H. S. JENNINGS and G. T. HARGITT, Johns Hopkins University.

Specimens of the 1,500th Generation of Paramecium, attained without Artificial Stimulation or Conjugation: L. L. WOODRUFF, Yale University.

HERBERT W. RAND,
Secretary

HARVARD UNIVERSITY

THE ASSOCIATION OF OFFICIAL SEED ANALYSTS

THE second annual meeting of the Association of Official Seed Analysts was held in Boston, December 28–29, 1909, in connection with the meeting of the American Association for the Advancement of Science.

Agricultural colleges, experiment stations and state departments of agriculture in twelve states and the Canadian and the United States departments of agriculture were represented.

Three papers were presented as follows:

"The Effect of Alternating Temperature on the Germination of Seeds," by W. L. Goss, U. S. Department of Agriculture.

"Importance of Uniform Methods of Seed Testing," by A. D. Selby, Ohio Agricultural Experiment Station.

"The Sale of Adulterated Farm Seeds in the United States," by E. Brown, U. S. Department of Agriculture.

The greater part of the time of the meeting was devoted to consideration of the reports of the committees on methods of seed testing and on legislation. The report on methods of seed testing for purity was adopted as official by the association and that on germination as provisional. The report on state legislation was adopted and the secretary was instructed to prepare both reports for publication.

E. BROWN,
Secretary

SOCIETIES AND ACADEMIES

THE THIRD ANNUAL MEETING OF THE ILLINOIS STATE ACADEMY OF SCIENCE

IN attendance, number and character of papers presented, and in the general spirit of enthusiasm and interest, the meeting at Urbana, February 18 and 19, is regarded with great satisfaction by those who had the good fortune to be present.

More than one hundred new members were elected, so that now the academy, while but three years old, has something more than four hundred names enrolled on its list—a fact which speaks well both for the enthusiasm and the spirit of helpfulness of Illinois men of science, and which repudiates the idea that men of science are recluses.

About one hundred and fifty people were present at the various meetings.

The program was as follows:

"Dr. A. W. French," In Memoriam, A. R. Crook.

"A Needed Piece of Work in the Interest of our Young Investigators in Biology," T. W. Galloway.

"The Vegetational History of a Blowout," H. A. Gleason. (Lantern.)

"Recent Habitat Changes in the Illinois River," Chas. C. Adams. (Lantern.)

"Forest Successions on Isle Royale," Wm. S. Cooper. (Lantern.)

"An Ecological Study of the Fish of a Small Stream," Thomas L. Hankinson.

Address of welcome by the president of the University of Illinois.

Presidential address—"Relations of the Illinois Academy of Science to the State," Stephen A. Forbes.