cannot be likened to blushing, but are evidently under the fish's control, and are intelligently used to its advantage.

The bony gar (Lepidosteus osseus) is another fish having decided control over the coloration of its scales. When this fish is at rest, the scales are pale blue, with a pink margin; and about the head and gill-covers there is a variety of brilliant hues. At times all these colors will suddenly disappear, and the fish has much more the appearance of a water-soaked stick than of a living animal. Unfortunately I have had too few opportunities for observing this species to determine the reasons for these changes; but it is evident that they are under the control of the fish, and therefore advantageous.

The common pike (Esox reticulatus) also exhibits a variation of coloring, under different circumstances, and suggests the same facts that have already been stated with regard to other species.

When the chief aim of biological science seemed to be the naming and describing of 'species,' it was found that no description of the color of a fish, unless very unusual and marked, was at all satisfactory. Considering the subject of color, as I have in this article, the cause is very evident.

In an early number of *Science*, I offered many reasons for believing that fishes were very far from spending as joyless, machine-like an existence as has been supposed. Those reasons I supplement with the results of studies of their habits, with reference to their brilliant tints and sombre hues, and am in accord with Mr. Romanes when he states that we are justified in regarding 'the presence of a color-sense in them as axiomatic.'

CHARLES C. ABBOTT.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROCEEDINGS OF THE SECTION OF BIOLOGY.

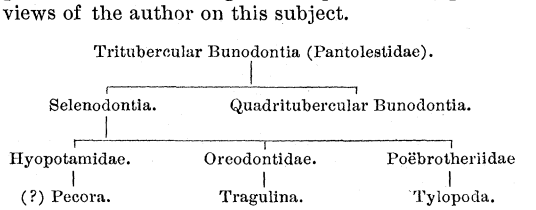
A LARGE number of papers (forty-three in all) were presented before the section of biology, but we regret that in our limited space we can give merely the briefest outlines. The first we may mention was a paper by Mr. H. G. Beyer, on the influence of oxygenated and unoxygenated blood, as well as of blood in various degrees of dilution, on the isolated heart of the frog and terrapin. The paper aimed to prove that it is not concentrated mammalian blood which produces the greatest amount of work done in either the heart of the frog or that of the terrapin, but a certain degree of dilution is necessary. There is no exception in the constant, stimulating influence in oxygenated blood, and none in the depressing effect of non-oxygenated blood.

Dr. C. S. Minot read a paper on biological problems. The author opposed the trinomial system, and considered the present mode of determining species entirely unscientific, and thought that the species should be based on a statistical study of all the variations that are known to occur. Individuals are not always homologous. The only fixed units are, 1° cells; 2° the whole series of generations of cells from a single ovum, — a cell-cycle. An individual may be almost any fractional part of a cell-cycle. Roughly speaking, the higher the organism, the fewer the number of individuals it comprises. The author considered the ovum to be homologous with the encysted protozoon, the zona radiator being equivalent to the capsule or cyst of the protozoon, and the contents also homologous.

In a paper by Lillie J. Martin on a botanical study of the mitegall found on the petiole of Juglans nigra, known as Erineum anomalum Schw., a general survey of the gall was given, as to position, number, general appearance, etc. This was followed by a description and comparison of the microscopical appearance of the gall and normal petiole, concluding with the supposition that the mite entered at an early period in the life of the petiole, and the growth of the gall was from within outward.

A paper by Prof. B. G. Wilder, on the relative position of the cerebrum and the cerebellum in anthropoid apes, was illustrated by photographs, and a preparation of a chimpanzee's brain; conclusively settling the much-disputed point, as to whether the cerebrum extended over the cerebellum or not, as the cerebrum was seen to extend at least a millimetre over the cerebellum.

Mr. E. D. Cope, in a paper on the phylogeny of the artiodactyle Mammalia derived from American fossils, considered the derivation of the seledont dentition from the bunodont as established from a mechanical point of view. The oldest American artiodactyl (Pantolestes) is bunodont. The modification proceeded as in other ruminant lines by the co-ossification of the bones of the legs and feet. The peculiar structure of the carpus in the Oreodontidae shows them to be, without doubt, the ancestors of the Tragulina. The following table represents the present views of the author on this subject.



In a paper on the torsion of leaves, Prof. W. J. Beal stated that he had studied the torsion of leaves produced by the effects of sunlight. Those twisting with the sun are two species of Typha, one species of Sparganium, Acorus, Tritallaria imperialis, and Liatris. Those twisting against the sun are two species of Allium, Iris, Gladiolus, oats, and Setaria. Twisting both ways are Allium cernuum, Phleum, Bromus, barley, Clawson wheat, Panicum, and Zizania. Cyperaceae, Setaria verticillata, S. viridis, and S. italica do not twist at all.

Mr. L. F. Ward read a paper on the fossil flora of the globe; treating the subject from historical, geological, and botanical standpoints.

The two oldest known species (Oldhamia) have been found in the Cambrian of Ireland. From the lower Silurian, 44 species are known, being chiefly marine algae; upper Silurian, 13 species. The ferns predominate among the 188 species known to the Devonian. In the Permo-carboniferous, nearly 2,000 species have been made out, while in the trias 67 are known. In the Rhetic, an advance seems to have been made, which increases to the oölite where 419 species have been found. The upper Jurassic and lower cretaceous are sparingly supplied with vegetal remains. The Cenomanian of Atam, Greenland, and the Dakota group of Kansas and Nebraska, give 500 species. The Turonian again is almost destitute. Senomanian yields 350 species, while the Laramie group of western United States gives 333 species; the tertiary eocene, 800; oligocene, a somewhat larger number, while the miocene gives more than 3,000; the pliocene gives only 150 species.

The first type is that of the Florideae, marine algae. Ferns, Equisetineae and Lycopodineae, appear in the lower Silurian. The Devonian of Canada and Brazil shows us the first appearance of the rhizocarps, while the monocotyledons first appear in the carboniferous. The dicotyledons have their first known representative in the Urogonian of Kome, Greenland. All the leading types of vegetation are introduced without going later down the geological scale than the middle cretaceous. Marine algae predominate in the Cambrian and early Silurian. Ferns flourish in the Permian; Equisetineae and Lycopodineae, in the carboniferous; Cycadaceae, in the lias or oölite; the Coniferae, in the Wealden; monocotyledons, in the eocene; monochlamydeous dicotyledons, in the cenomanian; polypetalous dicotyledons, in the miocene; and the gamopetalous dicotyledons, in the present living flora of the globe. Cellular cryptogams of some kind lived in the Laurentian, and account for the graphite beds there found. Ferns, Equisetineae and Lycopodineae, commenced in the lower Silurian, and had their maximum in the carboniferous. Cycadaceae have their origin in the Devonian, while the maximum is in the middle Jurassic. The Silurian shows the first Coniferae, which reach their maximum in the cretaceous, and then decline. Monocotyledons begin in the lower carboniferous, and have their maximum in the tertiary. Dicotyledons commence in the lower Jura, and the maximum is in the present age.

In a paper on fertility in hybridization, Mr. R. B. Roosevelt cited cases of hybridism between species of Salmonidae, and between Alosa sapidissima and the striped bass. In many cases hybridism greatly improves the species. He proved by an extensive practical knowledge that hybridism in fish at least by no means necessarily implies sterility.

Mr. H. F. Osborne presented observations on the amphibian brain, containing results of microscopic study upon the frog, Menobranchus, Menopoma, and Amphiuma. His method of study was by making series of sections, in three different planes. The relative position of gray and white matter was the same as that found in the spinal cord of these and other vertebrates. The course of the principal nerve-bundles extending from the medulla forward to the hemispheres was described, showing the course of the transverse commissures, and a commissure hitherto overlooked in the roof of the third ventricle was pointed out. This demonstrated that each brain segment had its own dorsal commissure. The differences of the cerebellum in the Anura and Urodela were pointed out, and the resemblances of the latter to the mammalian brain were dwelt upon. The pia blood-vessels are all sent in upon the anterior face of the pituitary body. The pineal elements were shown to consist of certain very inconspicuous foldings of the epithelium of the roof of the third ventricle, which have been generally overlooked. These foldings represent what remains of the stalk of the pineal gland.

Mr. S. Garman's paper on Chlamydoselachus, the frilled shark, treated of the internal anatomy of this peculiar shark. The nearest forms are Notidanidae, Hexanthus, and Heptanchus. Hind and fore brain resemble that of foetal sharks; the cartilage is soft; the lateral line is open as in foetal sharks, and continued to the end of the tail. The pelvis is twice as long as broad: the nearest resemblance to this is seen in the foetal Heptanchus.

The next paper was by Mr. E. D. Cope, on the mammalian affinities of saurians of the Permian epoch, and referred to the detection of mammalian resemblance between Theromorpha and reptiles of the Permian epoch. Resemblances in the pelvic and scapular arch were pointed out. The quadrate bone was discussed, referring to the theory of Albrecht. The genus Clepsydrops shows that it has the mammalian number of bones in its tarsus, and the resemblance was nearest to that found in the Platypus anatinus.

Dr. C. H. Merriam gave a paper on the hood of the hooded seal (Cystophora cristata); describing it as an inflatable proboscis overhanging the mouth, and extending posteriorly to a point behind the two eyes, lined with nasal mucous membrane, and divided longitudinally by two cartilages. It is not noticeable until the male has reached its fourth year.

In a paper on some points in the development of pelagic teleostean eggs, Mr. G. Brook, jun., first considered non-pelagic eggs; instancing those of trout, in which the hypoblast originates as an involution of the lower layer upon itself, the space between the

layers being quite distinct. In pelagic eggs the process is quite different. Sections of the eggs of Trachinus vipara at this stage show that the parablast of Klein, the intermediate layer of American authors, is made up of a large number of free cells, and nuclei are absorbed from the yolk, which contribute to a very great extent to build up the hypoblast. In this case, there is no true invagination. In Motella mustella the origin of the hypoblast is similar to that of Trachinus; but the resulting cells, instead of being quite similar to the original ones as usual in teleostean eggs, are very much larger, and hexagonal, so that they cannot be derived directly from the lower layer of cells. The author sustained the views of Ryder as regards the segmentation cavity in pelagic eggs. He also holds that there is no circulation in pelagic embryos before hatching.

Mr. G. Macloskie, in his paper on the dynamics of the insect crust, commenced with a general description of the chitinous skeleton with its in- and outgrowths, etc. The tracheae have spiral crenulations, which have been hitherto misunderstood and supposed to be threads; these tracheae transmit gases directly to the tissues, and the blood is not used for this purpose. The tracheae are not directly controlled by muscles; their action depending on the successive production of a partial vacuum, and condensation of air around them.

Prof. A. Hyatt read a paper on the larval theory of the origin of tissue, stating that the building-up of the tissues of the metazoa is due to a quick and rapid division of cells. Minot's theory that the origin of the sexes is due to the difference in cell elements was supported. The author considered the planula a more primitive form than the gastrula. In another paper Professor Hyatt presented objections to some commonly accepted views of heredity; asserting that heredity has no need of the gemmule hypothesis or pangenesis, but that it can be equally well understood upon the supposition that the nuclei of cells are the immediate agents of the transmission of characteristics. The author presented the case of a man in Maine who resembled the mother on one side of his body, and his father on the other side, as an illustration of his theory; and he contested the position of Professor Brooks as regards heredity. In a paper on the structure and affinities of Beatricea, the same author stated that this fossil has had many positions assigned to it in almost all the groups of the Invertebrata, though he himself now thought it a foraminifer. Thin sections were examined, the structure being found to consist of cells joined by a stolon.

Dr. C. S. Minot presented a paper on the skin of insects. The skin consists of three layers, — externally the cuticula, overlying an epithelium, which lies in turn on a sheet of connective tissue; the epithelium, homologous with the epithelium of other animals, and which should be so called instead of hypodermis; and dermis, which name should be applied to the connective tissue, as it is the homologue of that of vertebrates. The cuticula of caterpillars has not yet been fully described: it consists of two layers, a thick one and a thin one.

In a communication on the development of Limulus, Mr. J. S. Kingsley stated that his account begins after the formation of the blastoderm. At this time there is a single layer of cells surrounding the yolk, in which are scattered nuclei. The mesoblast arises as a single sheet on the ventral surface. Its cells come largely from the blastoderm, but some arise from the yolk nuclei. The mesoblast soon forms two longitudinal layers, one on each side in the neighborhood of the limbs. The coelom is formed by a splitting of the mesoblast, and at first consists of a series of metameric cavities extending into the limbs. The supraoesophageal ganglion arises by an invagination of the epiblast. The heart arises as two tubes in the somatophore, which later unite. The mesenteron does not appear until after hatching. The amnion of Packard is the first larval cuticle, and bears a resemblance to the amnion of the tracheata. A second cuticle is formed and moulted before hatching. The eyes appear on the dorsal surface at the same time that the limbs appear on the ventral. In these characters Limulus agrees essentially with the tracheata, and has nothing in common with crustacea.

Prof. B. G. Wilder, in a paper entitled, 'Do the cerebellum and oblongata represent two encephalic segments, or only one?' remarked that most writers had considered two segments to exist. The cephalad of these segments is held to include the cerebellum, together with the portion of the 'brain-stem' immediately connected therewith and the latter part of the oblongata. The only writers that have admitted of a single segment caudad of the mesen are Balfour, A. M. Marshall, Owen, and Spitzka. The views of Spitzka were then discussed; concluding with the opinion that sufficient evidence to settle the question was wanting.

Dr. J. A. Ryder presented a paper on the morphology and evolution of the tail of osseous fishes. The caudal fin of fishes is developed in the same way as the other median or unpaired fins, from a median fin-fold. After the protocercal stage of the larva is passed, a lower caudal lobe grows out, which is probably the homologue of a second anal fin. The hypotheses which grow out of a consideration of the facts of the development of the tails of fishes, are the following: 1. Whenever heterocercality manifests itself, there is a more or less extensive degeneration of the caudal end of the chordal axis, which began to be somewhat manifest far back in the phylum in such forms as Holocephali, Dipnoi, and crossopterygians. 2. With the outgrowth of the lower lobes (second anal) the energy of growth tended to push the tip of the chorda upward; the lobe itself arising, probably in consequence of the localization of the energy of growth and the deposit of organic material at the point according to the demands of use and effort. 3. Local use and effort, acting as constant stimuli of local growth, carried the heterocercal condition and its accompanying modification of degeneration and reduction still farther, as is shown by a study of the homologous elements in the tails of fishes; while use and effort would also continue to augment heterocercality, until the inferior and superior lobes were

about of the same length and area, when the morphological characters of the caudal fin would become approximately stable for any one species, as may be shown by measurements of a simple mechanical illustration, in which the interaction and composition of the forces which are brought into action are demonstrated. 4. The mechanical demonstration alluded to above, taken together with the fact that the primitive or ancestral form of the tail, which is typified by a temporary condition in fish larvae, when the myosomata are rudimentary, but still symmetrical, amounts almost to a demonstration of the principles first laid down by Lamarck, then elaborated by Spencer, and more recently applied to special cases by the author and Professor Cope.

In a communication on growth and death, Dr. C. S. Minot gave the results of ten thousand measurements of weight of growing guinea-pigs and other animals from birth to maturity. The rate of growth was found to steadily diminish from birth onward; so that the loss of power begins at once, and continues until death. The common views of death were discussed, and the current conceptions of animal individuality were attacked. The author then referred to the bearing of our present knowledge of senescence upon the theory of life, and the relation of life to a material substratum.

A paper on the osteology of Oreodon was read by Mr. W. B. Scott, in which this genus was said to belong to the Artiodactyla, although there are some strong resemblances to the Suidae. Vertebrae are ruminant, markedly in the case of the axis. Thoracic vertebrae have long prominent spines, and small bodies slightly amphicoelous. Lumbars, probably five in number, are heavy, with short spines and broad flat transverse processes. Sacrum contains two vertebrae which touch the ileum. The tail is long and slender, and the legs proportionally long. There are a short head and short metapodials, giving the animal a wolf-like appearance. The radius and ulna are distinct. The carpus consists of eight bones, including the pisiform. There are short unankylosed metacarpals. The ungual phalanges are long and pointed, as in Hyopotamus. A rudimentary pollex is present, this being the only artiodactyl with one.

Mr. J. Struthers, in a paper on finger-muscles in Megaptera longimana, and in other whales, records rudimentary flexor and extensor muscles in these animals, and shows that they are more or less used, as the muscular fibres are red and not degenerated.

Dr. G. M. Sternberg described his experimental research relating to the etiology of tuberculosis. The author repeated the inoculation experiments of Koch, with similar results. The experiments of Formad to induce tuberculosis in rabbits by introducing into the cavity of the abdomen finely powdered inorganic material, have also been repeated with entirely negative results. The author held that Koch's bacillus was an essential factor in the etiology of tuberculosis.

Dr. C. E. Bessey, in a paper on the adventitious inflorescence of Cuscuta glomerata, stated that the examination of young plants shows that the inflorescence is developed from numerous crowded adventitious buds, and not by the repeated branching of axillary flowering branches as commonly stated.

In a paper on the hitherto unknown mode of oviposition in the Carabidae, Prof. C. V. Riley records habits of Chlaenius impunctifrons, traced from the egg up. The eggs are laid singly in cells made of mud or clay, on the under surface of leaves.

Mrs. A. B. Blackwell read a paper on the comparative longevity of the sexes. The study was exhaustive, and made on statistics from all parts of the world; and the greater longevity of woman over man was established. In old countries the females preponderate, while males lead in newly settled ones. Up to eighteen years the males are in excess of the females: later the females predominate.

PROCEEDINGS OF THE SECTION OF HISTOLOGY AND MICROSCOPY.

THE attendance at this section was very small, partly because the other sections drew away not only many members, but many papers also; partly too, we imagine, because the American society of microscopists had held its annual meeting a short time previously. The future of this section is somewhat uncertain, especially because many of the members are unwilling to have their histological papers withdrawn from the section of biology. The abolition of the section was much discussed, not only among the members interested, but also in the section itself. As the number of communications and the attendance were both of the smallest, the feeling against the continuance of the section, with its separate organization and equal rank with the sections of physics, biology, geology, etc., became very decided with many of those most interested. Finally, Dr. C. S. Minot announced in general session, that he should bring up a motion to amend the constitution so that section G shall be abolished. This amendment will come up for consideration at the next meeting of the association.

Alexis A. Julien read a paper on an immersion apparatus for the determination of the temperature of the critical point in the fluid cavities of minerals. The extensive occurrence of carbon dioxide in minerals renders the determination of its critical point important; yet with the forms of apparatus hitherto described for this use, there have been sources of serious error. The author described a new device for raising a thin section of a mineral, mounted on a glass slide, to an accurately determinable temperature upon the stage of the microscope. The arrangement consists of a thin walled box heated by conduction from a taper through the copper plate which forms its bottom, and which projects beyond the stage. The thermometer has a scale ranging from 22° to 45° C.; each degree on the scale being two centimetres in length, and divided into tenths. The bore and length are so arranged as to bring that part of the scale near 30° on a level with the eye at the eye-piece, in order