sired are able to pass the examinations without special preparation, and it is not desired to afford any particular opportunity for such preparation.

With the exception of a few small laboratories where the field work is limited and promotion is not offered, the great majority of appointments to the various government laboratories are to subordinate positions and higher positions are filled by promotion whenever possible. Special qualifications are, therefore, not usually required.

I wish to emphasize the fact that every appointee should have pursued a broad general course of study. The argument is frequently made, and it is doubtless true, that the work for which the majority of appointments are primarily made, that is, the ordinary routine work of the laboratory, could be as well performed at the beginning by men who are not college graduates, and frequently by men whose training in chemistry itself has been very incomplete. It is found, however, that while such men may be satisfactory at the beginning, their potential power is limited. Men with special training are frequently desired for the purpose of conducting special investigations. This special training, however, should have been received in post-graduate study. The ability to conduct research work that is constantly required, the resource essential to emergencies and even the initiative required by those who take a responsible part in the routine work of the laboratory are rarely secured except in men with broad fundamental training.

W. D. Bigelow

THE AMERICAN SOCIETY OF ZOOLOGISTS

II.

A Comparison of the Cephalic Organs in Certain Sipunculids: John H. Gerould, Dartmouth College.

A comparison was made between the cephalic organs in *Phascolosoma verrillii*—an undescribed species from Vineyard Sound and Buzzards Bay, covered with prominent papillæ and characterized by having only a single pair of retractor muscles (ventral)—and the corresponding organs in *Sipunculus nudus* and in other forms.

P. verrillii has not only the ciliated nuchal organ of other *Phascolosomas* (*P. gouldii, P. vulgare*) but also a *cerebral organ,* that lies superficially between the nuchal organ and the mouth. In a young (postlarval) individual it forms a rounded elevation of surface epithelium dorsal to the mouth, but ventral, or oral, to the nuchal organ. In the adult (*P. verrillii, P. gouldii*) it becomes less conspicuous and elongated transversely in the frontal plane. It is closely connected with the brain (supra-esophageal ganglion) by a pair of large lateral cords containing (1) a pair of ocular tubes, which open dorso-laterally upon the surface of the cerebral organ, and (2), mesial to each ocular tube, the special neurones and a pair of sensory pits of the cerebral organ itself.

The cerebral organ in *Sipunculus nudus,* as Ward and, later, Metalnikoff have shown, projects into the bottom of a long tube which, opening upon the dorsal surface of the body slightly behind the tentacles, runs backward and inward to the cerebral organ. The latter and the corresponding organ upon the surface of the head in *Phascolosoma* have precisely similar relations to the brain; and ocular tubes open upon the surface of the cerebral organ in both forms. *Phymosoma* (*Physcosoma*) *varians,* as described by Shipley, shows an intermediate stage between the primitive condition in *Phascolosoma,* in which the cerebral organ is superficial, and that in *Sipunculus.*

Ocular tubes with pigmented walls were found in a specimen of *Sipunculus nudus*

from Beaufort, N. C., opening ventro-laterally upon the surface of the cerebral organ and running backward into the substance of the brain. The photic organs of *Sipunculus,* which hitherto have not been positively recognized, resemble those of *Phymosoma,* as described by Shipley; those of *Phascolosoma verrillii* differ from them in being relatively much larger and more highly developed, having in the middle of the ocular tube a spindle-shaped lens. The walls of the posterior part of each ocular tube are composed of long conical pigmented cells, of which the bases abut against the tube, the apices radiate into the surrounding tissues of the brain. Neurones with cylindrical distal ends, covered with longitudinal fibrillæ, lie in a group behind and below the posterior end of each ocular tube. They are probably adapted to receive photic stimuli, the impulse being transmitted from them, mainly over bipolar neurones, directly to the retractor muscles. The reaction time of these muscles to photic stimuli, in *P. vulgare* at least, is notably less than that of the longitudinal muscles of the body wall.

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

When a genus of trematodes is widely distributed over the earth it is probable that the species constituting it are not necessarily closely allied, but have, in certain cases at least, acquired a similar structure because they have been subjected to similar conditions of life through long periods of time. Thus the four species of the genus *Fasciola* inhabit the gall-passages of large herbivorous mammals in the four largest continents, and the ten species of the genus *Pneumonœces* living in the lungs of frogs and toads are almost as widely distributed. It is hard to see how the species in each of these genera, as well as in others that might be mentioned, could be descended from a common ancestor and have migrated from a common center to the localities where they are at present found, since the conditions of existence of a trematode, bearing as it does a fixed and very definite relation to two hosts, make migration a difficult matter for it. On the other hand, trematodes living in the livers of large herbivores or in the lungs of frogs and toads, even in very different parts of the world, have been subjected to identical and constant environmental conditions while passing through their phyletic developmental stages, with the result that they are now so similar in structure that they are classified in each of these cases in the same genus.

The Distribution of the Amphipods occurring in Bermuda: B. W. KUNKEL, Yale University.

The most interesting fact regarding the occurrence of the littoral amphipods of Bermuda is the large number of species which are also found in the Mediterranean. Of the 45 species, representative of 27 genera, which have been found in Bermudian waters, besides one species of *Cyamus* reported by Verrill from a whale landed at St. Georges, nearly one half (20–21) are common Mediterranean forms. Only four Bermuda species, which are not endemic, are wanting in the Mediterranean. Twenty species are apparently peculiar to Bermuda.

The amphipods of the West Indies and Central America, with which the Bermuda forms probably are most closely related, have not been at all carefully studied, so that at the present time it is impossible to draw any conclusions regarding the exact relationship of the two faunæ.

Next to the Mediterranean, the region which presents the greatest number of species in common with Bermuda is Great Britain with 14 species; then follows the

coast of France, Spain, and the Netherlands with 11; and then Scandinavia with 10 species. From Oceania have been collected 10 or 11 species which are known also in Bermuda, from the Red sea 7, and from the Indian Ocean 5. Six of the Bermuda species are essentially world wide in their distribution.

Individual Action of the Ganglia of the Razor-shell Clam, Ensis directus: GILMAN A. DREW, University of Maine.

Although accessory ganglia are reported to occur on the cerebro-visceral connectives of Solen, serial sections and dissections have not shown them in this form.

Both cerebral and visceral ganglia are able to receive sensory impulses and to send out motor impulses, when isolated from other ganglia. When the cerebro-pedal connectives are cut, stimulation of the surface of the foot causes only local contractions. The foot as a whole does not respond. This seems to indicate either that the pedal ganglia have no motor cells or that the sensory neurons from the foot are continued through the pedal ganglia to the cerebral without endings or collaterals. The latter arrangement seems more probable for the following reasons: (1) Many ganglion cells are present in the pedal ganglia and sensory cells alone would hardly be expected in such a muscular organ as the foot. (2) Cutting the cerebro-pedal connectives causes tetanic contractions of the whole foot and not single twitches. (3) With both cerebro-pedal connectives cut, stimulation of one connective causes complete contraction of the whole foot, an action that is very different from that obtained by stimulating the pedal nerves of one side after they have been separated from the ganglia. This seems to show that the stimulus is received by the ganglia and referred by association fibers to the motor cells that control the movements of the entire foot.

The Physiology of the Stomach of Higher Crustacea: LEONARD W. WILLIAMS.

The cardiac canals described by the author in the lobster's stomach have been found also in *Astacus, Cambarus, Nethrops, Squilla* and in the fiddler, common, spider and hermit crabs. The lower canal alone exists in the isopod *Idothea* and in the amphipod *Talorchestia.* The general occurrence of these canals in higher crustacea, as well as in larval lobsters, indicates their physiological importance. It is believed that they bring to the pyloric cushions or pads the nutrient fluid and suspended particles which are freed by the gastric mill and which enter the canals between the closely interlocking bristles of the side and floor of the cardiac sac. In the pyloric cushions, the fluid is again filtered and then enters the large digestive gland ("liver"), while the particles caught in the cushion are carried backward into the hind gut.

Relation of Instinct to Intelligence in Birds: FRANCIS H. HERRICK, Western Reserve University.

The Breeding Habits of the Loggerhead Turtle and Some Early Instincts of the Young: DAVENPORT HOOKER, Yale University.

The breeding season of the loggerhead turtle lasts through the months of April, May and June. There seems to be basis for belief that two nests are laid in a season by each female. The number of eggs laid is approximately one hundred. The period of incubation lasts about fifty days.

Experimentation on the newly-hatched young gave results which may be briefly stated as follows: (1) They have an inherent tendency to descend inclines and are positively phototropic. Both tenden-

cies may act together, the first, however, slightly dominating the second. By means of these tendencies the young turtles find the water. (2) After twelve hours at the outside, their phototropism is lost. (3) Swimming and floating are congenital instincts, but diving is a process which must be learned. (4) After entering the water, there is a definite period of "getting out to sea," as it were, followed by a definite period of rest. (5) The edibility of each object encountered is tested, *i. e.*, there is no instinctive selection of a particular food.

The Experimental Control of Asymmetry at Different Stages in the Development of the Lobster: V. E. EMMEL, Harvard Medical School.

A series of experiments were made at the following stages in the development of the lobster: (1) the second larval stage, (2) the fourth stage, (3) fifth stage, (4) twelfth stage or year-old lobsters. All of these experiments attempt to determine to what extent asymmetrical differentiation of the chelæ can be controlled by the amputation of one chela, thus giving the remaining chela the greater opportunity for growth.

The results of these various experiments support the following conclusions:

1. That in the first four larval stages of the lobster, the development of right or left asymmetry can be controlled by the amputation of one of the chelæ.

2. During the fifth stage the controlling influence of such amputations disappears.

3. In later stages when the asymmetry of the chelæ has become normally established, the amputation of neither one nor both chelæ will produce a reversal of asymmetry.

4. And finally, since up to the fifth stage either right or left asymmetry of the chelæ can be produced at the will of the experimenter, this asymmetry does not appear, therefore, to be directly predetermined or inherited, but may be controlled by factors arising in the course of development. What these factors are, has not been determined, but the present results do not indicate that they are "an inverse organization" of the egg, or an "alteration in the localization of germinal substances."

The Specific Gravity of the Constituent Parts of the Egg of Chætopterus and the Effect of Centrifuging on the Polarity of the Egg: F. R. LILLIE, University of Chicago. (To be published in the Proceedings of the Central Branch.)

Instance of a New Species of Crustacean, apparently in Process of Evolution: ADDISON E. VERRILL, Yale University.

An account was given of a peculiar race of the grapsoid genus, *Sesarma,* studied in Bermuda, in 1901. The common species in Bermuda (*S. Ricordi*) lives ordinarily at and just above high-tide level, within easy reach of water. It is often seen running actively about among the stones and dead seaweeds. It may almost always be found under masses of *Sargassum* cast up on the shores, as well as under stones.

The new form seems to be a subspecies of a variety of *S. Ricordi,* which may be actually in process of development into a genuine species, by natural selection and physiological isolation.

It was found living under stones in dry upland fields and nearly barren waste lands with thin soil, where the scanty vegetation consisted of wiry grasses and dwarfed shrubs and weeds. It was associated with a few species of ants, beetles, cockroaches, spiders, land-shells, etc. When the stones were turned over it usually ran away very actively and sought shelter under other stones, but did not seek the water, as most species do. Its general appearance was very unlike *S. Ricordi.*

The carapace appears more rough and

uneven than in the ordinary form, for it is more strongly areolated and the branchial areas are more swollen, so that the vertical thickness is greater and the reticulated areas of the sides are broader, giving a larger surface for aeration of the water, and indicating larger gill-cavities and gills. The dorsal surface of the carapace is covered with more numerous and larger granules, bearing numerous short dark hairs, very evident under a lens of low power, and capable of holding adherent dirt.

The ambulatory legs are distinctly larger and longer than in the common form. The proportion of the merus joints of these legs to the breadth of the carapace is 1:1.36. In *Ricordi,* 1:1.5.

The colors, when living, appear dull or sordid yellowish brown, or mud-color, due partly to adherent dirt, but often specked or mottled with red or reddish brown.

It is not improbable that it has the habit of eating different food from its parent species, and also a somewhat different breeding season, so that the two forms may no longer interbreed. This could not be determined at the season of the year when we were in Bermuda.

The young crabs, moulting from the megalops at the shore, have evidently inherited the instinct to seek the higher and drier localities, where they probably have fewer enemies. The modifications that have taken place are in accordance with the change in habitat. The increased hairiness of the carapace and legs serves to retain the dirt that aids materially in their concealment when exposed. Probably they feed mostly at night. The larger gill capacity and longer legs have evident advantages.

That it is not a casual or transitory variation is evident from the fact that there are, in the museum of Yale University, several good, characteristic, adult specimens sent to us before 1866 (perhaps collected as early as 1855), by J. Matthew Jones, Esq., who resided in Bermuda for many years, during the colder seasons, and whose first book on Bermuda was published in 1859.

The evolution and habits of this race of crabs would furnish a good subject for investigation by some one connected with the Bermuda Biological Station. The varietal or subspecific name, *terrestris,* indicating its marked terrestrial habits, is given to it by the author.

The Meaning of the Color Variations of Litorina palliata: F. B. Sumner and Jas. W. Underwood.

This mollusk offers a striking example of apparent protective coloration, nearly all of its varieties harmonizing beautifully with one or another part of the rock weed on which it dwells. This resemblance relates not only to the general color, but to the shape of the shells, which, on their natural background, strongly suggest the floats of the weed. On analysis, however, the popular explanation of the phenomenon as due to the natural selection of the more favorably colored individuals, seems far from certain. (1) There is no tendency whatever for the mollusk to choose a background resembling its own particular color rather than one conspicuously unlike it. (2) In nature, the red and brown shells are found statistically to be present in about the same proportions on the *Ascophyllum* as on the *Fucus,* although the latter alone displays red or brown tints in its foliage. (3) The green element in the color of many of the shells, which is an important factor in bringing about the harmony with their surroundings, is found to be due to certain algæ inhabiting their superficial layers. It is thus an entirely adventitious color, and these same algæ are found in abundance on

other shells, dead or alive. (4) Another mollusk of this genus, *Litorina rudis,* displays nearly all of the color variations to be found in *palliata,* yet *rudis* lives on the bare rocks, and is very seldom found upon the weed. (5) Experiments (still incomplete), in which the mollusks were exposed to the attacks of the tautog, point to the conclusion that this fish is nearly or quite as likely to pick out one of the mollusks from a background of a harmonious color as from one which is not in the least harmonious.

Some Experiments in Heredity in Mice: T. H. MORGAN, Columbia University.

A wild "sport" of the house mouse, having a pure white belly, slightly yellowish flanks, and gray dorsal surface, was crossed with the principal types of domesticated breeds (black, chocolate, white) having uniform or self-colored coat. The white belly dominates in the first generation, although the spotted coat of domesticated races is recessive to the uniform coat. Thus the same character, viz., spotted coat, is dominant in one form and recessive in the other. When the sport with white belly is crossed with domesticated spotted mice the white-bellied character dominates. Crosses between the sport and yellow mice give some yellows. These are whitish below, but appear to show no more white than do ordinary yellows, so that it is not possible to ascribe the result to the dominance of the sport. The absence of a sharp line in the yellow hybrids between the yellow and white would seem rather to indicate that the yellow coat as a whole dominates the spotted coat of the sport, which seems paradoxical in the light of the relation of the spotted coat of the sport to the uniform coat of other colors. Cuénot's important experiments with yellow mice have shown that mice of this color always throw mice of other colors in definite proportions. He accounts for the result on the basis of selective fertilization—a yellow-bearing germ cell never fertilizing another yellow-bearing germ cell, but always one bearing another color. The following result shows that the peculiar behavior of the yellow color in inheritance is not due to selective fertilization, but to a different condition. A yellow mouse crossed with a black-and-white waltzer of pure strain, produced some yellows. A pair of these yellows inbred gave yellow, black, chocolate and albino mice. The result shows on analysis that the yellow germ cells must carry other colors, as well as yellow, and that these colors reappear in the next generation.

The Limb Muscles of Necturus, and their Bearing upon the Question of Limb Homology: H. H. WILDER, Smith College.

The bones and muscles of the distal half of both fore and hind limbs in *Necturus* were reviewed by means of charts and drawings. These show a remarkable degree of correspondence, extending often to minor details, but there is no such correspondence in the proximal portion (proximal to elbow and knee).

This almost perfect correspondence in the case of what is perhaps the most primitive land vertebrate is of far more significance than if we had found it in some modified form, and suggests very forcibly the serial homology between the limbs of the same side, and in the normal position (syntropism). Certainly, if we recognize an homology between the very variant appendages of the decapods, we can hardly refuse it in the case of this primitive salamander. There is at present the greatest need of a universal set of terms to be applied equally to similar parts in the fore and hind limbs of vertebrates, but this manifestly rests upon the establishment of

a scheme of limb homology that can be generally agreed upon.

That such a nomenclature is possible for *Necturus* was demonstrated by the employment of one in the descriptive part of the present paper. The confusion resulting from a lack of such a set of terms was shown by the reading of the first paragraph from a recent paper by Baum (*Anat. Anz.*).

Distribution and Variations of the Deep-sea Stony Corals from off the Coast of the United States: Addison E. Verrill, Yale University.

In this paper distribution was given of the fourteen species of stony corals (*Madreporaria*) dredged by the U. S. Fish Commission in deep water, from off Cape Hatteras to the Newfoundland Banks, with illustrations of some of the more notable variations by means of lantern slides. Several of the species descend to depths below 1,000 fathoms; one was taken in 1,742 fathoms. Most of those from the greater depths have a very wide geographical range, some of them being found from the Gulf of Mexico to the Arctic Ocean, and on both sides of the Atlantic. Among those from the greater depths are the following: *Flabellum Goodei,* 164 to 1,178 fathoms, from over 100 stations; *F. angulatum,* 906 to 1,742 fathoms, most abundant at 1,396, 1,434 and 1,722 fathoms, taken at 14 stations; *Caryophyllia communis,* from 636 to 1,356 fathoms, 13 stations; *Desmophyllum cristagalli,* from 1,054 to 1,060 fathoms, 2 stations.

Habits, Reactions and Mating Instincts of the "Walkingstick," Aplopus mayeri: Chas. R. Stockard, Cornell Medical School.

The habits of *Aplopus* on its food-plant *Suriana maritima* are as protectively adapted as is its singular stick-like appearance. In color and form the large female resembles the stems of this plant, the males are greenish and inconspicuous among the leafed twigs, while the eggs are peculiarly similar to the seed of *Suriana* in size and color. This insect is nocturnal, moving only occasionally in the daylight. It walks in a slow stiff manner, often swinging its body from side to side, suggesting the motion of a branch shaken by the wind. To escape its enemies the insect may drop from its position and become lost among the lower branches, or may fall entirely to the ground and lie motionless, feigning death for several minutes.

Aplopi respond to light and darkness, being more sensitive to the former. When they are blinded by painting their eyes they still respond, though slower than when normal.

These insects during the day, while inactive, may be made to assume an endless variety of awkward positions, any of which may be maintained for some time. They may actually be piled over one another with their backs down and legs extended in the air as if they were inanimate sticks. This stick-like indifference often causes them to be passed unnoticed by enemies.

When the animal walks its antennæ are circled in front of the head as if feeling the way. On removing the antennæ the first pair of legs are used as "feelers," if these are now cut away the legs of the second pair are pressed into service and alternately waved about as "feelers." When such a four-legged antennaless individual has its eyes blinded it becomes confused and turns in a circle, but improves in its movements with practise.

A portion of the abdomen of a mature female was attached to a stick supported on wire legs thus forming an imitation female. Males in a dark room were found to mate in a normal manner with this abdomen on the stick. Such an experiment makes it evident that a courtship or

psychical response is not essential between the sexes in mating.

Some Notable Cases of Radical Variation and Regeneration in Starfishes and Ophiurans: ADDISON E. VERRILL, Yale University. (Read by title.)

The following demonstrations were exhibited:

Some Maturation Stages of the Mouse Egg: J. A. LONG (by E. L. Mark).

Preparations showing the Maturation, Fertilization, and Cleavage of the Eggs of the Mouse and Rat: WESLEY R. COE and W. B. KIRKHAM.

The Organ of Claus in the Copepod Eucalanus: C. O. ESTERLY (by E. L. Mark).

Photographs of Triplet Calves: RAYMOND PEARL.

Photographs of Wing of Fowl with Three Extra Digits: GILMAN A. DREW.

A Series of Embryos of the Loggerhead Turtle: DAVENPORT HOOKER.

Model of a Portion of the Lumen of the Spermatophoric Gland of the Squid: L. W. WILLIAMS.

Color Variations of Litorina palliata: F. B. SUMNER and J. W. UNDERWOOD.

Morphological Variation during the Life-Cycle of Infusoria: LORANDE LOSS WOODRUFF.

LORANDE LOSS WOODRUFF,
Secretary

YALE UNIVERSITY

THE AMERICAN SOCIETY OF BIOLOGICAL CHEMISTS

THE first annual session of the American Society of Biological Chemists was held at the University of Chicago during convocation week, from December 30, 1907, to January 2, 1908, inclusive. Four meetings were held, with the scientific programs indicated below:

First Meeting

Physiology Building. Monday afternoon, December 30, 1907.

Presiding officer: The president, Russell H. Chittenden.

Program

"The Rate of Oxidation of the Sugars in an Acid Medium," by H. H. Bunzel (by invitation).

"On the Efficiency of Thymol and Refrigeration for the Preservation of Urine, as shown by Comparative Analyses for the Various Nitrogenous Constituents at the End of 24, 48, 72 and 96 hours," by P. B. Hawk and H. S. Grindley.

"Comparative Tests of Spiro's and Folin's Methods for the Determination of Ammonia and Urea," by Paul E. Howe and P. B. Hawk.

"A Study of the Relative Therapeutic Value of Antitoxic Globulin Solution and the Whole Serum," by Edwin J. Banzhaf (by invitation).

"The Quantitative Changes during Immunization in the Blood of Horses and the Relation of the Serum Globulin to Diphtheria and Tetanus Antitoxin Content," by Edwin J. Banzhaf and Robert B. Gibson.

"The Compressibility of Gelatin Solutions and of Muscle," by Lawrence J. Henderson and F. N. Brink.

"The Efficiency of the Neutrality Regulation in the Animal Organism," by Lawrence J. Henderson.

"On Glycosuria," by Hugh McGuigan.

"A Comparison of Waymouth Reid's and Schenck's Methods for the Estimation of Sugar in Blood," by J. J. R. Macleod.

"Eosinophilia and Indicanuria," by C. H. Neilson.

Second Meeting

Physiology Building. Tuesday morning, December 31, 1907. Joint session with the American Physiological Society.

Presiding officers: The president of the American Society of Biological Chemists, Russell H. Chittenden, and the president of the American Physiological Society, William H. Howell.

Program

"Protein Metabolism in Fasting," by Otto Folin.

"Experimental Glycosuria," by J. J. R. Macleod.

"Further Observations on the Parenteral Utilization of Carbohydrates," by Lafayette B. Mendel.