but as a production of the age of Galileo, Harvey, Gilbert and Keppler, it does not appear as a marvelous performance. The only circumstance at which one hesitates is that a scientific chemist, whose mind moved in the world of reality and veracity, should have mixed the description of his experiments with so much degraded bombast. We can only surmise that the wealthy Thölde, or the master spirit behind him, purchased these secrets of antimony from some indigent chemist and worked them into the otherwise nonsensical book in which they appear.

C. S. Pierce.

STUDIES FROM THE ZOOLOGICAL LABORATORY, HARVARD UNIVERSITY.

The following abstracts of papers prepared in the Zoological Laboratory of the Museum of Comparative Zoology at Harvard College have been made by the authors. The final papers will be published as soon as the plates necessary for their illustration can be prepared. Other papers, not readily given in abstract, or requiring illustrations to make them intelligible in that form, will be published soon.

E. L. Mark.

Ovogenesis in Distaplia occidentalis Ritter (MS.), *with Remarks on other Forms.* (Abstract.) By F. W. Bancroft.

The material was all obtained on the coast of California. In the compound ascidian *Distaplia*, only, was it attempted to make the investigation at all complete. Here the development of the sexual organs, though in several respects simpler, conforms to the type described by Van Beneden et Julin in 1885. Both ovary and testis are derived from a common fundament, which, on account of the differentiated oögonia it contains, is recognizable in even the smallest buds of the older colonies.

One of the diagnostic characters of the genus *Distaplia* is the capacious brood pouch in which the embryos are kept. It is attached to the zoöid by a narrow stalk and has usually been described as a diverticulum of the peribranchial sac. The embryos are arranged so that the youngest are at the tip of the organ. It was found to be not a simple diverticulum; the stalk of the pouch is double, consisting of two narrow tubes, one of which is a continuation of the oviduct, while the other opens into the peribranchial sac. The oviducal tube opens into the bottom of the pouch, and it is on account of this arrangement that the younger embryos are always found in the tip of the organ. In passing from the ovary to the pouch the ovum is greatly compressed, assuming the shape of a sausage, but becomes oval as soon as it has entered the pouch.

The test cells are seen to be derived from the follicular epithelium, and not, as Davidoff has maintained for this genus, from within the ovum. The cytoplasm of the test cells has been stained from the earliest stages on, and strands of cytoplasm are seen during all the earlier stages connecting the test cell with the follicle in somewhat the same way that Morgan has described. However, at this period, bends in the wall of the germinative vesicle and accompanying vacuoles in the cytoplasm are occasionally encountered, and it is likely that these appearances are what has been described by Davidoff as nuclear evaginations from which the test cells are formed. They are probably due to shrinkage. There are also deeply staining granules in the cytoplasm, which often have vacuoles around them, and then look exactly like Davidoff's figures of nuclear buds that have already become detached from the germinative vesicle. But they do not produce the test cells, as this author thinks. The test cells are found to take no part in the formation of the test of the embryo, as has recently been maintained by Salensky. The outermost

follicular epithelium, which remains behind in the ovary when the ovum passes into the pouch, forms a very conspicuous corpus luteum, which persists for a considerable period.

In the colonies studied, both the youngest buds and the the adult zoöids contained about the same number of oögonia, so that in these the whole of the ovogenesis consists in growth and maturation only. The yolk bodies, which are very large, begin to be formed at the periphery of the ovum when it has reached about half its final diameter. At this time the germinative vesicle has reached its maximum size; it has a full outline, a conspicuous stained network and a large nucleolus. From now on, while most of the yolk is formed and the ovum acquires the last seven-eighths of its ultimate volume, the germinative vesicle decreases in size, until it has but half its maximum diameter, acquires a stellate outline and a marked avidity for most stains. The shrinking of the germinative vesicle, then, is not associated with maturation in this case, but with yolk formation.

The nucleolus, though usually obscured by most stains, persists with little change throughout this shrinking. It does not form the stellate body found in the old ova, as Davidoff maintained, but is found within this body, which is itself the remains of the germinative vesicle. The nucleolus at this stage is quite complex, consisting of a homogeneous cortex, an eccentric finely granular medulla, and within the latter several very highly refractive bodies, the largest of which may have a granular appearance. During the greater part of the growing period these refractive bodies are the only substance in the germinative vesicle that takes the chromatin stain with a methyl green and acid fuchsin combination. However, shortly before the egg leaves the ovary chromatin is detected in other regions of the vesicle, so that it is probable that the tetrads are not formed from any part of the nucleolus. These refractive bodies persist even after the ovum has passed into the oviduct and the rest of the nucleolus, together with the germinative membrane, can no longer be seen.

The tetrads, of which there appear to be normally twelve, are formed during the passage of the egg through the oviduct. Two polar cells are formed, but in neither of the divisions accompanying their production nor in any of the earlier cleavages has any centrosome, aster or spindle fibre been found, although several good preparations of these stages have been obtained. In all of these processes the amount of granular undifferentiated cytoplasm is very small; by far the greater part of the ovum is filled with yolk bodies, between which no interstitial cytoplasm can be detected. It may be that the absence of these characteristic accompaniments of mitosis is due to the small amount of active cytoplasm present.

Observations on Non-Sexual Reproduction in Dero vaga. (Abstract.) By T. W. GALLOWAY.

BUDDING may take place in any of the setigerous segments from the 16th to the 21st.

Number of segment.....	16	17	18	19	20	21
Percentage of occurrence...	7.6	15.3	38.2	26.7	7.6	4.6

In the anterior zoöid subsequent bud-zones are produced in the same segment in which the first occurred. When the posterior individual reproduces, the bud-zone may be in the segment bearing the same number as that of the anterior zoöid, or it may be in front or posterior to that segment. It is thus the posterior zoöid which introduces the variability. In Dero the relation between the normal increase of segments and budding is such as to suggest

that the latter is a specialized form of the former.

The place of separation is interseptal; the anterior half-segment produces an anal segment and a preanal, undifferentiated, segment-forming zone; the posterior half forms four cephalic segments and the prostomium.

The ectoderm by ingrowths between the longitudinal muscle bands produces in the posterior zoöid the brain, the circumœsophageal connective, the sub-œsophageal ganglia, four pairs of ventral bristle-sacs and two latero-ventral invaginations, the walls of which contribute to the formation of the buccal wall. The floor and roof of the mouth are also ectodermal, but are formed, upon the separation of the zoöids, by the free mid-dorsal and mid-ventral margins of the body wall, which are drawn into contact with the entoderm by muscular action. In the anterior zoöid the ectodermic ingrowths fuse with one another and with mesodermal elements to form an undifferentiated zone, from which new segments are added to this zoöid. The nerve cord, the dorsal and ventral bristle sacs, and the peripheral portions of the nephridial organs, are contributed by the ectoderm.

The entoderm increases in thickness throughout the bud-zone by the multiplication of sub-epithelial cells. In two regions this becomes pronounced. In the posterior zoöid a thick wall of long, columnar, ciliate epithelial cells is produced, surrounding the old tube. This outer wall soon becomes separated from the old wall by a distinct space, the lumen of the new pharynx. Anteriorly this new pharyngeal wall becomes continuous with the ectodermal portion of the wall of the mouth; posteriorly it extends to the dissepiment bounding the bud-zone. The wall of the old gut continues functional until the individuals separate, and is then detached and swallowed. In the anterior zoöid there is a thickening of entoderm immediately in front of the future plane of division. This arises in a way wholly similar to the pharyngeal wall, and, like it, becomes separated from the wall of the gut. It is cilitated and is destined to become the wall of the pavilion, which probably subserves a respiratory function. From the mesoderm arise new muscular fibres, blood vessels and dissepiments.

Effect of Temperature on Growth of Tadpoles. (Abstract.) By T. W. Galloway.

Tadpoles of Rana, Amblystoma and Bufo were reared, without other food than was contained in the eggs, under different temperature conditions (varying from + 16° to + 25°C.), to an age of 30 to 70 days. Through a comparison of the total weight, the dry weight, the amount of water and the ratio of the dry weight to the total weight, the following conclusions were reached: (1) Increase of temperature, within the above limits, accelerates cleavage and the rate of imbibition of water (especially the latter), but does not appear to produce any definite change, either of increase or decrease, of formed substance; (2) organisms reared in the warmer conditions tend to attain a slightly higher maximum percentage of water than those subjected to lower temperatures; and (3) individuals reared for sometime in a low temperature showed, after transfer to a higher temperature, a greater rate of imbibition of water than those kept from the beginning in the warmer chamber.

Structure and Development of the Antennal Glands in Homarus americanus. (Abstract.) By F. C. Waite.

The adult organ consists of three portions, an endsac, labyrinth and vesicle. The endsac lies spread over the dorsal face of the labyrinth, and closely applied to it. These two portions of the gland are in communication at one point only, which is in

the anterior region of the organ. The labyrinth is continuous at its anterior median lobe with a short duct which leads to the exterior and opens on a tubercle on the base of the antenna. The large vesicle lies dorsal to the endsac and opens into the duct leading from the labyrinth, but has no direct communication with either the endsac or labyrinth. The histological structure of the labyrinth and endsac are different and the transition at the point of communication between their cavities is sharp. The histological structure of the vesicle is very much like that of the labyrinth.

The first appearance of the organ in the development of the embryo is at the time when the first and second pair of antennæ, the mandibles and the first maxillæ are marked off. This is approximately 15 to 18 days after egg extrusion in summer (August) eggs. The organ at first consists of a differentiation of certain mesodermic cells in the axis of the second antenna near its proximal end. These form the endsac. The lumen is intracellular. About ten days after the first differentiation of the cells which are destined to form the endsac, and at a time when this part of the organ is well marked, there appears an ectodermic ingrowth from the ventral face of the second antenna. It is at first solid, but within a short time an intercellular lumen is formed. From this ectodermic ingrowth arise the labyrinth, the duct to the exterior, and the vesicle. Thus the two parts arise independently, one from the mesoderm, the other from the ectoderm, and each has characteristic histological conditions throughout development. They are both well marked and with distinct lumina at about six weeks (for summer eggs) after egg extrusion, but not until a comparatively late period of embryonic development (about one month before hatching) do the lumina of these two parts become confluent. At the time of hatching each part is a relatively simple sac, but during larval life a complexity approaching that in the adult organ is reached. This is brought about by a series of evaginations of the walls of the sacs, which later anastomose in a variety of ways, and not by the coiling of a tubule. The histological conditions seem to indicate that the organ is not functional until the beginning of larval life.

The results obtained as to the development are in general accord with the conditions found by Kingsley in Crangon and by Boutchinsky in Gebia, but are at variance with the development of the organ in Astacus as described by Reichenbach.

RAISED SHORE-LINES ON CAPE MAYSI, CUBA.

AT the eastern end of the island of Cuba, on and in the vicinity of the promontory known as Cape Maysi, is the most magnificent example of raised shore-lines as seen from the ocean that I know of. They are in the form of huge wave-cut benches extending with perfect regularity and practical horizontality along the face of a long moderate slope and around several promontories. When a profile of the latter is seen from a passing ship the sharp-cut, step-like form readily attracts the attention even of the unscientific observer. The terraces are found one above another at somewhat irregular intervals, are of different degrees of development, possibly as much as a dozen in number, and seem to extend to an altitude of about 1,000 feet above the sea. Above the last terrace visible the land has a topography indicative of sub-aërial erosion. The view is backed by the high range of the Copper Mountains, whose crest along this portion of the island is smooth and even compared with most West Indian mountain ranges.

To the geologist the terraces of Cape Maysi are chiefly interesting because they demonstrate a recent uplift of this part of the island of Cuba. This is singular, be-