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NOTES IN BIOLOGY

EDITED BY

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THE SPERM–RECEPTACLE OF CAMBARUS.

BY E. A. ANDREWS.

In 1870 Hagen showed that American crayfishes of the genus
Cambarus that is almost all found East of the Rocky Mountains,
possessed in the female a peculiar organ which he called the
annulus ventralis and used as one of the specific characters since
it presented marked peculiarities in each species.   Since then
other authors have made even more use of this organ as a char-
acter which, like the appendages of the anterior part of the
abdomen of the male, may be relied upon as of specific value.
But the physiological value of the organ was not known till 1895
when I described the male as transferring sperm from the male
passages into the annulus ventralis of the female.

Observations and experiments since then have convinced me
that the annulus ventralis is a necessary sperm receptacle without
which the eggs would not be fertilized.   The annulus ventralis
is a necessary secondary sexual organ and its use forms so integral
a part of the complex sexual habits of the crayfish Cambarus
that deprivation of the annulus would now lead to extermina-
tion of these crayfishes from the loss of an essential link in the

chain of reproductive organs. This applies to the sixty-six or so species of Cambarus as contrasted with the thirty-seven or so species of crayfish of other genera in all other parts of the world, and if we were to accept Ortmann's conclusions it would follow that the annulus vertralis with its sixty odd forms must have been evolved since the lower tertiary in the present region of the United States to the East of the Rocky Mountains.

Scarcely anything being known of the internal anatomy of this important organ it seemed worth while to make a study of its anatomy, the main results of which are here published in anticipation of a more complete account elsewhere.

This sperm receptacle may be described as an elevation of the areolar connective tissue full of blood, and on the ventral side of the body beneath the nerve cord.   This elevation is covered by that part of the common epidermis, which makes the peculiar mass of exoskeleton appearing externally as the annulus ventralis of the systematists. '

The connective-tissue mass lies just beneath the lower end of the descending artery that forks to pass forward and backward as the sternal artery.   It is thus just beneath that separation of the commissures between the ganglia innervating the fifth and the fourth pairs of legs which allows the descending artery to pass down on the middle line with a commissure on its right and on its left.

The living part of the organ, the epidermis and vascular tissue, has the same shape as the exoskeleton which it produces and fills out the exoskeleton as the crumb of a loaf of bread fills out the crust.

The following description and illustrations refer only to the exoskeleton made over the epidermis of the organ ; to the part of the organ that with the general exoskeleton is cast off at the period of change of shell.   This part of the exoskeleton is especially dense, hard chitin, more or less calcified and with a smooth surface destitute of setæ or hairs.   No glandular nor sensory parts were found in connection with the annulus but merely a chitinous pocket opening to the exterior only.

C. affinis from the Potomac, Maryland, has been the chief

species studied.   Here the annulus, as seen from the outside, is
an elevation of the exoskeleton transversely elongated and lying
across the middle of the ventral side of the body between the
fourth and fifth pairs of legs.   Its general form is represented in
Figure 1 which is from a clay model of the exoskeleton of the
annulus.   Toward the centre are two large elevations and pos-
terior to them a transverse depression bounded by an elevated
rim which is thicker at its middle where it shows a sharp median
line, a suture or groove.   This suture passes forward and with a
sharp bend to the right goes down the anterior face of the thick
rim to change its direction again sharply to the left, finally
ending in an opening that is somewhat to the left of the middle
and partly overhung by the large elevations.   The right elevation
sends a spur, or ridge, to the left partly under the left elevation
and this spur tends to intrude upon the opening that it bounds,
in a manner not shown in the model.   As this is a ventral view
the terms right and left here used for the model will be reversed
when we later speak of the animals' right and left.

When this part of the exoskeleton is cut away from the rest,
as may easily be done, and torn away from the underlying
epidermis and connective tissue it presents from the dorsal side
the appearance shown in Figure 2 which is the obverse of the
above model.   This shows that the two large elevations of Figure
1 are hollow protrusions of the exoskeleton since they appear as
deep pits from this dorsal view.   The whole organ is an elevation
since it shows as a dish-like depression within a bounding rim,
in this dorsal view.   The transverse depression of Figure 1 is
represented by a transverse elevation across the bottom of the
dish posterior to the pits in Figure 2.   Most striking, however,
from this dorsal view is the appearance of a large curved elevated
ridge lying lengthwise across the dish between the pits and
across the elevated middle and depressed posterior part of the
organ.   This ridge is not shown on the ventral view (Figure 1)
but it lies just above the zig-zag suture and its anterior end is
above the orifice at the end of the zig-zag.   In fact the ridge is
a very thick-walled trumpet, or cornucopia, opening to the
exterior at its anterior end and closed at its posterior tip.   The

cavity of the trumpet is, however, not completely closed but opens along its entire length by an exceedingly narrow fissure that comes to the surface of the animal along the zig-zag line.

It is this peculiarly bent, trumpet-shaped cavity that is used as a sperm-receptacle : this cavity is the essential part of the annulus.

The shape of this cavity is indicated in figures 3 and 4 which represent a model of an imaginary casting of the cavity enlarged about 100 diameters. In life the cavity may be quite filled by sperm and a waxlike mass given by the male so that these figures also represent the shape of the mass transferred from males to the female. Figure 3 represents a cast of the cavity as it would look if seen from the outside of the animal after all the rest of the annulus had been dissolved away. The enlarged anterior end shows, in white, the somewhat crescentric orifice of the trumpet and passing back from it the zig-zag suture that comes to the surface of the animal. The zig-zag suture connects with the more cylindrical part of the trumpet by curved, oblique planes as follows : The anterior part of the zig-zag connects with the anterior part of the trumpet by a plane extending obliquely forward, toward the right and away from the surface ; the middle part of the suture connects with the smaller part of the trumpet by an oblique plane passing anteriorly and to the left away from the surface ; and the posterior limb of the zig-zag with the posterior terminal part of the trumpet by an oblique plane passing to the left and posteriorly away from the surface. As indicated in the dorsal view (Figure 4) the trumpet is bent not only from left to right but also up and down so that its posterior tip is on a different level from its anterior end and main course. The posterior end, in fact passes abruptly downward to end in the thick, median enlargement of the posterior rim shown in Figure 1 and is just beneath the median suture.

As indicated in Figures 3 and 4 there is a peculiar modification of the posterior end of the trumpet, a bilobed recess, or a pair of lateral pouches, connected posteriorly and dorsally with one another, and near the surface, with the canal of the trumpet, anteriorly.

This recess lies a little distance from the surface of the animal and its pouches discharge only indirectly through the median plane. The median suture extends posteriorly beyond the recess and there is thus formed an extension of the plane not part of the immediate connection of surface suture and trumpet canal. Similar extensions may occur at each angle of the suture, as represented in Figures 3 and 4. These minor planes are but extensions of the major planes and all are in reality but exceedingly narrow, curved, microscopic clefts reaching out from the curved canal of the trumpet to the suture at the surface.

Morphologically we may regard this bent cavity of the annulus as a flat pocket, opening to the exterior and conceive it as made by an invagination of the epidermis lined by very thick chitin and almost completely closed except at one end, the anterior end, though there remains an exceedingly narrow microscopic chink along the whole length of the pocket.

If we imagine a long flat pocket of stiff material to be folded from side to side while its mouth is made shorter than its bottom line, we might have its mouth bent into a zig-zag line and its bottom thrown into a sinuous line connected with the zig-zag mouth by a series of curved planes as in the annulus. In addition the imaginary pocket would need to have one end of its mouth more opened and the other end pushed out laterally as a small two-lobed recess to represent the cavity of the annulus as shown in Figures 3 and 4.

The absence of bilateral symmetry in the annulus is worthy of note. While the crayfish as a whole is markedly bilaterally symmetrical and while unpaired, median organs usually have exactly equal right and left halves, the annulus has a zig-zag suture and bent cavity that are not balanced right and left. The aperture leading into the receptacle is on the right of the median plane of the animal ; one limb of the sigmoid trumpet is more to the left, one more to the right ; the larger superficial protuberance is on the left side and sends its spur across the median plane under the protuberance of the right side and this protuberance lacks such a spur. Even the recess which lies across the median plane is not equally balanced right and left

since one side-pouch is larger than the other, as is not well shown in the figures.

While the majority of females in *C. affinis* have the parts of the annulus placed with reference to the median plane as above noticed there are not a few in which the symmetry is exactly reversed. In these "left handed" annuli the orifice into the trumpet lies upon the animal's left, the zig-zag runs forward, first to the right and then to the left ; it is the right prominence that extends across the median plane under the left prominence ; and even the recess has its larger pouch upon the opposite side to that usual in "right handed" annuli. Such reverses suggest those of spiral molluscs.

With marked differences in detail and in the character of external sculpturing the annuli of *C. affinis, C. Bartoni, C. Clarki, C. immunis* and *C. virilis,* all have the same essential anatomy, are to be regarded as bent pockets with a free opening and a nearly closed suture. Presumably all Cambari have sperm receptacles of the same general nature.

Such being the structure of the annulus ventralis, the chief facts as to its use, as I have determined them, may be summarized as follows :

In *C. affinis, C. virilis* and *C. immunis,* the males have been seen transferring the sperm from the papillæ of the vasa deferentia to the cavity of the annulus by means of the first and second pairs of abdominal appendages.

In *C. affinis* the sperm so forced into the trumpet-shaped cavity of the annulus fills all the posterior part, but not the wider anterior part. That part is completely filled by a wax-like secretion forced in by the male and completely sealing the sperm from contact with the water. An excess of this material protrudes, as a conspicuous white plug, from the orifice of the annulus and is but slowly worn off and disintegrated.

The males are active in filling the receptacles of females in Autumn, Winter and Spring, but the eggs are not laid till March and at least several weeks intervene between the time of reception of sperm and the time of laying. In some experiments females isolated in November, laid eggs the following Spring that devel-

oped normally though the only available sperm for fertilizing them had been kept in the receptacle some five months.

The sperms soon disintegrate in water but within the receptacle they are protected from the water by the wax plug and by the close opposition of the sides of the curved slit leading from the tube to the exterior. The clear cuticle over the outside of the exoskeleton may also aid in sealing up the zig-zag suture.

Extirpation of the annulus before laying was followed by the death of the eggs, though they were laid and attached to the female swimmerets as usual.

Extirpation of the annulus after laying did not interfere with the development of the eggs. After laying, the sperm receptacle is no longer full of sperm though the wax plug remains and the first part of the trumpet is tightly filled up even in June and July—a month and more after the young have hatched out of the eggs.

But not all the sperm issues out of the receptacle at the time of laying ; much may remain and in some cases the " recess " may be full of it as late as the middle of June.

An estimate of the number of sperms within the receptacle before laying gave 60,000 to 100,000 and after laying, sometimes 10,000 or so, of which some 6000 might be in the recess when it was still full.

As there are but three to six hundred eggs laid by a female at one time, the number of sperms liberated from the receptacle is ample to fertilize all the eggs. Rarely do any of the eggs fail to develop ; except for causes probably other than lack of fertilization.

Though parthenogenesis may not be impossible, the observation of male and female pronuclei within eggs adds to the improbability of its occurrence here.

Stained sections of annuli preserved a few minutes after the actually observed laying and of others removed within twenty-four hours after laying, show sperms passing through the slits that lead from the tubular part of the receptacle to the zig-zag suture, then issuing out of the suture and spreading out over the surface

of the annulus.   This spreading of the sperm is, possibly, due to surface tension phenomena.

The sperms spreading over the surface of the annulus still had the same unexpanded form and tightly coiled up arms that they had while within the receptacle, or within the vasa deferentia and testes of the male and elsewhere described.[1]   The osmotic factors necessary to produce the expanded form are not yet present, since water is kept away from the sperms by the presence of a large mass of mucus-like glaire secreted from the cement glands of the abdomen and covering the annulus and neighboring parts as well as the entire ventral face of the abdomen.

During laying, the female holds the fifth pair of legs in such a way as to suggest strong pressure of the peculiar sternal plate of the movable fifth thoracic somite against the posterior face of the annulus : artificial pressure exerted by forceps in pressing that plate against the annulus led to the oozing out of sperm through the zig-zag suture.   Preparations of such annuli are so similar to preparations of normal annuli removed soon after laying, that it seems most probable that mechanical pressure exerted by the female is an important factor in bringing about the discharge of sperm from the receptacle at the time of laying. In experiments strong pressure from behind sometimes started the wax plug outward, somewhat.

The anatomy of the receptacle interpreted as a bent pocket seems to favor the view that a compressing force applied pos-teriorly might buckle the bent planes and open passages along the suture out of which the sperm would be forced by a com-pression of the tubular part of the organ.

At the time of laying, the eggs were seen to flow out of the oviducts and to glide down over the annulus, directed by gravity and by the conformation of the sternal plates.   They thus have a good opportunity to come into contact with the sperms spread out over the annulus and to be fertilized.

While Cambarus is the only crayfish known to have a sperm receptacle, there is in the American lobster a sperm receptacle as

[1] Crayfish Spermatozoa, *Anatomische Anzeiger*, xxv, 1904.

first described by Bumpus, which is analogous to the annulus of
Cambarus and I have by strong pressure of the bases of the
legs in a dead lobster, caused sperm to ooze out of the receptacle,
suggesting that mechanical pressure may be a factor in discharg-
ing the sperm as it seems to be in Cambarus.   The observations
of Scott as to the posturing of the European lobster while laying
may also favor the view that the above observations upon Cam-
barus will find a close parallel in the habits of the lobster when
these are known in detail.

But any such close similarities in the use of the annulus in
Cambarus and of the receptacle in the lobster must be regarded
as interesting cases of independent evolution, so long as we hold
that Cambarus is the most specialized of the crayfish.

GADOW'S HYPOTHESIS OF "ORTHOGENETIC VARIATION" IN CHELONIA.[1]

WITH A NOTE ON DIVERSITY IN ITS RELATION TO LOCALITY OR SPECIES.

BY ROBERT E. COKER.

1.   "ORTHOGENETIC VARIATION."

In a paper entitled "Orthogenetic Variation in the Shells of
Chelonia,"[2] Dr. Hans Gadow presents the results of comparison
of 76 loggerhead sea turtles, *Thalassochelys caretta*, in regard
to the scutes of the carapace.   The most striking conclusion
reached in his paper may best be stated by quoting his own
words.

"Our turtles start with many, with at least 24 dorsal scutes
(leaving out the marginals), and they reduce them to 16.   In

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[1] This paper is based in part on observations made while in the employ
of the Bureau of Fisheries.   These data are used by permission of Hon.
George M. Bowers, Commissioner of Fish and Fisheries.

[2] "Zoological Results Based on Material from New Britain, New Guinea,
Loyalty Islands and elsewhere, collected during the years 1895, 1896, and
1897, by Arthur Willey"—Part III., pp. 207–222, Pl. xxiv, xxv—Camb.
Univ. Press, May, 1899.

other genera the reduction has advanced to 14, to 13, and individually even to 12.

"This means onward development. The ideal, the goal for the young Caretta is the possession of a 16 scuted shell. Those which start with 24 perhaps never reach the ideal, but this failure does not seem to hurt them, natural selection remains indifferent. Others start with 22, 21, 20, 19, or 18 scutes, and the latter individuals are rather common in the newly hatched stage, and all of these seem to reach the goal. Lastly there are some *precocious* [italics mine, R. E. C.] turtlets of the same brood, which start with the right number of 16 scutes, but if they devote their superfluous energy to something better than the making of tortoise-shell we do not know.

"Anyhow this is onward development. These variations from the normal type all lie in the direct line of descent and the more serious the variation, the further back it points. Moreover the changes necessary to turn any given variation into another one less abnormal until ultimately the normal condition is reached, are not erratic but stand in strict correlation with each other and proceed strictly on definite lines. I *therefore call this kind of atavistic variation orthogenetic.*

"Of course there is no proof of what I have tried to explain. Comparative anatomy and common sense tell us it is so. But common sense is not evidence in a sceptical court. The only way of proving the correctness of the view explained in this paper would be to take a number of abnormal turtlets and to watch, while they are growing up, if and how they mend their irregular shells and become normal." [1]

This assumption of a *determinate variation* in the individual turtle rests on a comparison of 76 specimens of *Thalassochelys* (20 from the Willey collections—new-born, from one nest and all abnormal,—and the remainder from various museums) 51 of which were abnormal in number and arrangement of scutes. The material, arranged in groups according to size, gives the following series of percentages of abnormal specimens :

93.6 % of new-born turtlets (47 specimens in all, 44 abnormal).

[1] Loc. cit., pp. 221, 222.

33 % of turtlets 3 to 8 inches in length (*9 specimens, 3 abnormal*).

26 % of those 8 to 24 inches in length (*19 specimens, 5 abnormal—the 19 includes 6 of the 9 forming the preceding group*).

14 % of the "large" specimens (*7 specimens, 1 abnormal*).

"This table shows that the abnormalities are 4 to 7 times as common in the new-born as in the mature specimens, and that their frequency decreases from the smaller to the larger and very large specimens.

"We have no business whatever to assume that our little turtlets which are born with irregular scutes are therefore doomed to perdition, while only those born with the normal number are predestined to live and propagate the race. Such an assumption is at once contradicted by the fact that no less than 14 % [*1 specimen! R. E. C.*] of large turtles are wrong in their scutes, and do, or did very well, for all we know to the contrary."[1]

It is fair to ask if, in the data given in Gadow's paper, there is warrant for the assumption made from them. The fact that the variants sometimes correspond to supposed stages in the phylogenetic line does not prove, nor necessarily bear on the assumption that an individual passes through a series of such reminiscent abnormalities. Granting that many, or even all, of the abnormalities may be grouped, as is done in his paper, so as to form a natural series, this is no evidence that an individual turtle passes through this series ; especially in view of the fact that a 24 inch specimen possessed 23 dorsal scutes, and the only abnormal full-grown turtle 20,— *these two having the highest numbers of any of his turtles older than the new-born !*

However suggestive may be the comparison of the variation series with an inferred phylogenetic series, we find no evidence for Gadow's assumption regarding the mending of abnormal shells, other than the series of percentages. But the fallacy of drawing such a comprehensive conclusion from a series of percents based on 44 specimens out of 47, 3 out of 9, 5 out of 19 (counting again 6 of the preceding) and 1 out of 7, is too apparent.

[1] Loc. cit., p. 221.

But supposing that observation of a large number of turtles of all sizes should show that there is a proportionately greater number of abnormalities among new born than among older turtles, would this necessarily indicate that turtles outgrow their abnormalities? It is hardly conceivable that the success of a turtle in the struggle for existence would hinge on whether it was the possessor of 10 or 11 costal scutes ; but it is quite conceivable that many of the abnormalities, at least the more extreme cases, may be but one of the evidences of a congenital weakness, or of some organic disturbance that occurred during the embryonic period, and that the total results of the weakness or disturbance may place the abnormal individual at a serious disadvantage, in comparison with its fellows. May it not be, then, that a greater proportion of abnormal than of normal turtles fail in the struggle ?

We know that there are abnormalities in the bony carapace, frequently in apparent correlation [1] with irregularities in the horny layer,—although these two tissues have very distinct origins (ectodermal and mesodermal). Abnormalities are not absent in internal organs ; and we know not what deficiencies there may be in the fine adjustments of the nervous system, involving those reactive functions which are of such prime importance not only in escape from enemies, but in capture of prey. To speak from observation of diamond-back terrapins, there are among these Chelonians very great differences in rapidity of motion, in promptness of approach at sight of food, and in boldness in taking food and in contending with fellow turtles for it. Thus abnormalities and variations are by no means restricted to scutes but are found —whether in correlation or occurring independently—presumably in every system of the body. Certainly in our present ignorance

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[1] Parker, G. H.—"Correlated Abnormalities in the Scutes and Bony Plates of the Carapace of the Sculptured Tortoise." *American Naturalist*, xxxv, No. 409, 1901.

Coker, R. E.—"Diversity in the Horny Scutes and Bony Plates of Chelonia." Paper presented at Annual Meeting of the American Society of Zoologists, 1904. (Abstract in *Science*, N. S. Vol. xxi, No. 532, 1905.)

of the extent of correlation between such variations and abnormalities—some apparently of indifferent value, others of evident selective value,—we have no right to regard it as incredible that a larger proportion of turtles with normal scutes than of those with abnormal scutes are among the successful in the battle of life, or to assert that "Natural Selection remains indifferent."

The words already quoted, "In other genera the reduction has advanced to 14, to 13 and individually even to 12" (pp. 9, 10, above) imply that Gadow postulates his hypothesis for turtles in general. Indeed, it does not seem probable that such a feature in ontogeny, as this supposed "orthogenetic variation," could apply to a single species.

Gadow's position seems to be without support in any facts he has brought forward, but the question has been raised and it seems proper here to summarize some new observations so far as they bear on this subject. The question is—Is there, in the normal life-history of a turtle, a reduction in the number of scutes, so that if we could have a series of photographs of a single turtle taken at intervals during its life-history, embryonic and post-embryonic, they would show us a series of different conditions of scutal arrangement, the large number of scutes in the first term of the series being reduced in the course of the series to the smaller number typical of adults? In brief, is there "determinate variation" in the *individual turtle?*

The observations that follow are based largely on material obtained at Beaufort, N. C., in connection with the fishery experiments of the United States Bureau of Fisheries and the North Carolina Geological Survey. The paper has been prepared in the Biological Laboratory of the Johns Hopkins University.

OBSERVATIONS.

Malaclemmys.

Examination of nearly 250 specimens of the diamond-back terrapin, (*Malaclemmys centrata*, Latr.) fails to reveal any sig-

nificant difference in that species in the proportions of old and young with supernumerary scutes.   While percentages based on small numbers are not of great value, the following series of per cents may be given for comparison with Gadow's series :

	No. observed.	No. abnormal.	Per cent.
Less than 3 years old, including 17 embryos and new-born,	32	6	18.75
Females, (aged 3 years or more) over 3 inches and less than 5 inches,	79	17	21.5
Females, (aged 3 years or more) 5 inches and over,	56	16	28.6
Males, over 3 inches,	71	10	14.1
Total,	238	49	20.6

Explanation of the Table.

Observations in detail will be given in a paper now in preparation ; for present purposes, no abnormality is considered other than that of the possession of either more or less than the typical number of scutes in the carapace.   The *age*, including incubation period, is inferred from the rings of growth ; thus none of the 32 specimens of the first group had more than two rings ; all of those of the remaining groups had more than two.   The *size* is the length of the plastron in inches.   In this species *females* grow much more rapidly and to a larger size than *males ;* therefore the sexes should be considered separately in this table.   Of these terrapin, 50 were observed at Crisfield, Md., 188 were from points on the North Carolina coast, chiefly about Beaufort, N. C.   See Figs. 2, 3 and 7, for representative abnormal specimens ; Fig. 1 represents a normal carapace.

The above figures certainly afford no evidence of fusion or squeezing out of scutes.   At first glance they seem to indicate the reverse.   But when we observe that females seem to vary in greater degree than males in respect of number of scutes, and bear in mind that the first group embraces both sexes, the figures are reasonably consistent.   Thus, if the average percentage for males is in the neighborhood of 14, and that for females in the neighborhood of 24, the average for both sexes would be in the neighborhood of 19, and the figures in the table above, are fully as consistent as can be expected of figures based on small numbers.
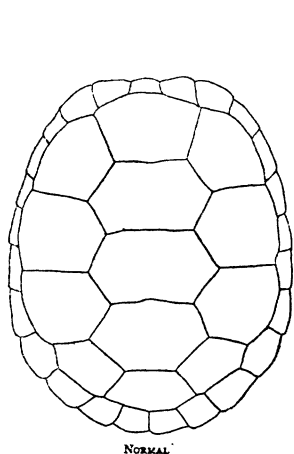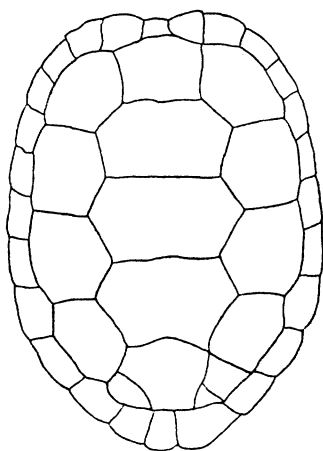
FIG. 1.   FIG. 2.

FIG. 1. Normal carapace of *Malaclemmys centrata*, Latr. Median dorsal series of scutes, consisting of small anterior *nuchal*, and 5 larger *neurals*; 2 dorso-lateral series, the *costals*, each consisting of 4 large scutes ; and 12 pairs of *marginals*. (x ½)

FIG. 2. Abnormal carapace of *Malaclemmys centrata*, Latr. *6* costals in right series; *5* in left series ; *13* left marginals.   Observe that 12th and 13th marginals of left side are equivalent in size to the 12th marginal of right side. (x ½)
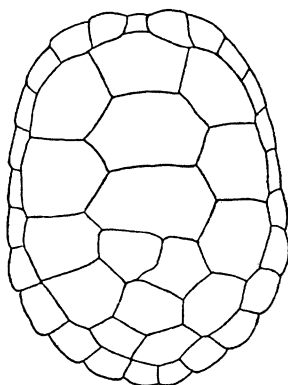

FIG. 3.

FIG. 3. Abnormal carapace of *Malaclemmys centrata*, Latr. 4th neural represented by an asymmetrical pair of scutes; a 7th neural, and a 5th left costal (or pair of 6th neurals?). (x ½)

In this connection it may be mentioned that the only cases observed of individuals with less than the typical number of scutes were two small terrapin each with two distinct rings of growth—that is, they were *less than 3 years of age.*

When the method of growth of the horny carapace is recalled, it is difficult to believe that fusion of the scutes could occur without there being in the adult carapace some evidence of this phenomenon.　The horny covering of the carapace
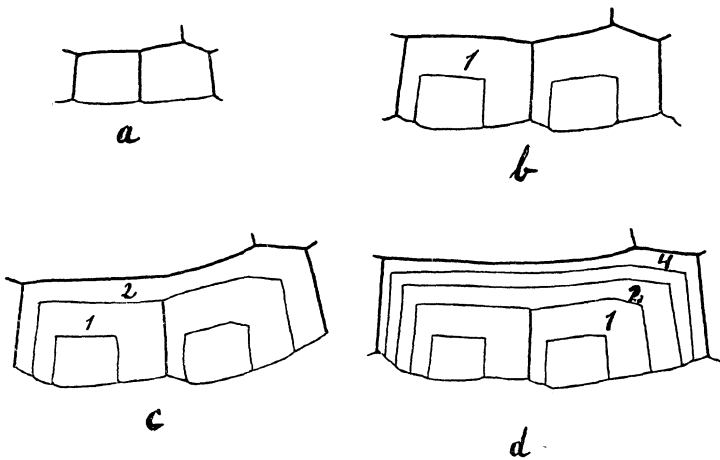

FIG. 4.

FIG. 4.　Diagram illustrating "incomplete fusion" of scutes.

　　a)　Two marginal scutes before beginning of first (post-embryonic) period of growth.

　　b)　The same, after one year of growth.

　　c)　The same, after another period of growth : instead of a ring of growth about each scute, a single ring is formed about both scutes.

　　d)　The same, after 4 periods of growth : third and fourth rings formed like the second.

of the terrapin grows by the addition of "concentric" rings around the original birth scute (see Fig. 7).　If, therefore, two originally distinct scutes lose their identities, we may expect that the story may usually be read in the adult carapace—that we would find two birth scutes, or "areolae," both (with the rings of growth that were formed before fusion, if any) enclosed within
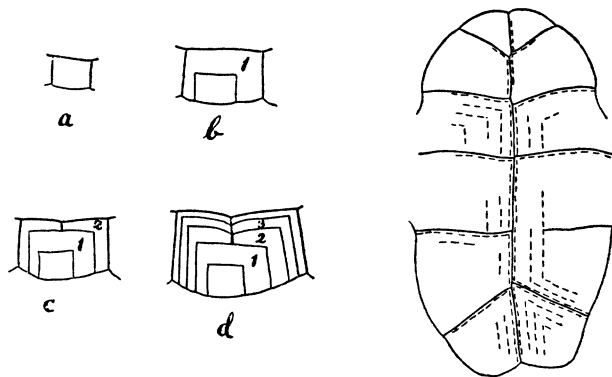
FIG. 5.   FIG. 6.

FIG. 5. Diagrams illustrating "partial division" of a scute:

  a) A marginal scute, before post-embryonic growth.

  b) The same, after one year of growth.

  c) The same, after two years of growth : the second ring of growth is divided.

  d) The same, after four years of growth : third and fourth rings formed like the second.

FIG. 6. Plastron of a specimen of *Malaclemmys* with abdominal and femoral scutes of left side partly "fused." The shell was somewhat worn ; where the growth lines show clearly in the photograph from which the drawing was made, they are indicated by dotted lines. (x⅓)
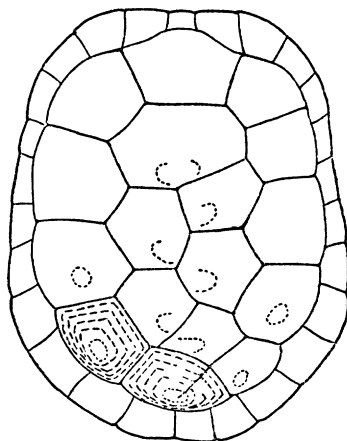

FIG. 7.

FIG. 7. Abnormal carapace of *Malaclemmys*: *5* right costals, *13* right marginals, neurals abnormal ; most posterior neural incompletely divided.

  Broken lines represent lines between successive rings of growth ; the outlines of the "areolae" are indicated in several of the scutes by dotted lines. (x½-cir.)

the same later rings.   Fig. 4 illustrates the supposed case of two marginal scutes "fusing" after having grown separately for a period.

In the case of "division" of a scute, we should expect to find the later rings of growth around a single areola formed about two different "centers," [1] as illustrated in Fig. 5, where a marginal scute is represented as "dividing" with the commencement of its second period of growth.

Our expectations are confirmed by the finding of two cases of such "fusion" and several of "division." [2]   Only one of the instances of "fusion" is in the carapace, the other is in the plastron—the right abdominal and femoral scutes being continuous mesially : that is, the later rings of growth are continuous (see Fig. 6).   In the only instance noted in the carapace the second and third right marginals are continuous mesially.

In the way of partial "division" : in one specimen, the 11th and 12th right marginals are continuous distally ; in another, the 3rd neural (4th median) is represented by an incompletely separated pair, continuous posteriorly ; in a third, the first right marginal has all rings of growth divided, [3]—that is, formed about different centers.   In the most posterior neural of a fourth carapace (Fig. 7), an antero-lateral suture crosses all rings of growth and a part of the areola ; apparently the rings are not intersected posteriorly.

Several considerations should be borne in mind :

First, there are more cases of *division* than of *fusion*.

Second, in both cases of fusion—one in carapace and one in plastron — and in most of the instances of division, the

[1] Since a scute grows more on some sides than on others, the areola is only a theoretical "center" for rings formed subsequently to the first.

[2] In the abstract of my former paper (cited, p. 12, above) it is said in regard to such variations : "Rare instances are found of a peculiar form of variation that may be termed 'orthogenetic.'"   The statement is incorrect as worded.   While such abnormalities are comparable to the phenomena we should expect as the normal result of "orthogenetic variation," that term is hardly applicable to them.

[3] Other more or less doubtful instances in the neurals of this turtle.

fusion or division tends to *increase the abnormality* of the specimen ; the tendency is not toward, *but away from the type :* if the fusion or the division could have become complete, the specimen would have been more abnormal than before.[1]

Finally, we have noted no fusion or division of things once separate—in fact no *actual fusion* or *division* at all—merely the facts that a single scute may have its later rings of growth formed about two different centers, giving the appearance of incomplete division, and that two scutes may share in common their later rings, giving the appearance of incomplete fusion. Even as it is, such cases are not very common. We are entirely without evidence that areas of two adjacent scutes, *which have formed separately* (as growth rings "1," "1," in Fig. 4), ever lose their identities and fuse with each other, or that an area *once formed entire* (as the areola, or ring "1," of Fig. 5) can afterwards divide by a suture.

The record would be obscured in specimens in which the outer laminae of the horny layer scaled off while new layers were formed below. In such cases, not uncommon, but unexplained, and presumably abnormal, the lines of growth on scutes and bony plates are obscured or entirely lost. The sutures between scutes, however, remain distinct and we have no reason to suppose that they do not retain their original arrangement ; of course we know no *a priori* reason for assuming that they *must.*

Since the specimens described above confirm our expectation that, where "fusion" or "division" of scutes occurs in ontogeny, the record can usually be read from the adult carapace,

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[1] In regard to one of his specimens (No. 28), Gadow mentions that the "1st and 2nd neurals" are "partly fused with each other." As this specimen has only the normal number of neurals, and as the 1st and 2nd neurals appear perfectly normal in the figure ("fusion" not indicated in the figure—Fig. 22), it would seem that this partial fusion, instead of mending the shell, was the only thing that made these two scutes or any part of the neural series abnormal. I cannot see how this turtle or such specimens as his Nos. 17 and 24, where one neural certainly represents more than one normal scute, can fit into a theory of "orthogenetic variation" : by what *straight line* could the turtle develop to pass through them?

they confirm the belief that in *Malaclemmys* we do not have "orthogenetic variation" in the sense that there is normally in the individual life-history a progressive reduction in the number of scutes.

Thalassochelys.

The observations given above were made on a species quite different from that (*Thalassochleys caretta*) on which Gadow's observations are based, and it is conceivable that "orthogenetic variation" occurs in one species but not in another. A small number of observations have been made on embryos of *Thalassochelys*, and these, as far as they go, bear strongly against Gadow's hypothesis.

From a nest of *Thalassochelys*, transplanted, the day after the eggs were laid, from the ocean beach to the Fisheries Laboratory at Beaufort, N. C., 35 embryos were taken of all sizes from .68″ to 1.58″ carapace length, the latter size being that of a turtlet just hatched. In 7, including the 5 smallest, the scutes are not distinct enough to be counted with certainty. The observations on the remaining 28 will be given later in detail; but their bearing on Gadow's hypothesis may be judged from the following summary.

The youngest 10 (L.[1] .75 to .86) average 41.2 scutes per carapace (range : 40–43). The next 9 (L. .86 to 1.08) average 41.4 scutes per carapace (range : 39–45). The largest 9 (L. 1.13 to 1.58) average 42.2 scutes per carapace (range : 40–44). These numbers include median, costal, and marginal scutes. The normal number is 40 or 42, according as the typical number of marginals on a side be supposed to be 12 or 13.

If we confine attention to median and costal scutes, then, instead of finding evidence of starting with 24 scutes and reducing to 16, we obtain from the three groups described above the following series : 16.2 (range : 16 to 17), 16.4 (range : 15 to 19); 17 (range : 6 to 20). The relative frequency of the different numbers may be seen from the following table :

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[1] L.—length of carapace (measured with calipers) in inches.

No. of median and costal scutes. Several groups, according to size.	15	16	17	18	19	20
1st group. L. .75. D. .86. (10)		8	2			
2d group. L. .86. D. 1.08. (9)	2	4	1		2	
3d group. L. 1.13. D. 1.58. (9)		5	1	2		1
Total, (28)	2	17	4	2	2	1

These embryos, developing, it is true, under abnormal conditions, but under conditions that we have no reason to believe would make them more "precocious," lend no support to an hypothesis of reduction by squeezing out or fusion. It would be difficult, too, to explain as "precocity" one of the embryos of .86 in., length of carapace, that has only 4 costal scutes on one side. The same deficiency was observed in several others.

It cannot be claimed that we have sufficient evidence on which to affirm the normal fixity of the abnormalities in the carapace of an abnormal *Thalassochelys*; but it is safe to say that Gadow's assumption is not warranted by the facts now in hand, and that the evidence so far adduced is opposed to it.

II.   Diversity in its Relation to Locality or Species.

Thalassochelys.

It is of interest that such a large proportion of the new-born turtles observed by Gadow — everyone of the lot of 20 in the Willey collections—were abnormal, and that such extreme cases were found as specimens with 24 median and costal scutes. The majority of his specimens came from Pacific and Indian waters. Some of the specimens on which my observations were made show marked abnormalities, but none have such large numbers of median and costal scutes : 20 is the most possessed by any of my turtles, while more than one-fourth of the whole number

of his have 20 or more.   This discrepancy [1] may be but an acci-
dent, but we are not without reasons for supposing that, in the
same species, the diversity may present different aspects in
different geographic regions.   The difference between Gadow's
specimens and mine is no greater than that between those of his
specimens that we know to have come from the Atlantic or
Mediterranean and those, the majority, that came from Pacific
or Indian waters.[2] Thus none of the 9 Atlantic or Mediterranean
specimens have more than 17 median and costal scutes : this may
be an accident too, but the possibility of such a difference being
characteristic suggests a necessity for caution in drawing conclu-
sions from a series of turtles when the individuals are gathered
indiscriminately from various geographic regions.   It may be
that Atlantic and Pacific loggerhead sea turtles belong, respec-
tively, to different species.[3]

Malaclemmys.

In regard to *Malaclemmys*, Professor W. P. Hay has observed
the relative abundance among diamond-back terrapins in Texas
of specimens with paired neural scutes : this condition is appar-

[1] The discrepancy is greater than appears at first : my specimen has 20,
counting both scutes of the pair of nuchals.   In Gadow's table such a pair
is counted as one ("double") scute.   The scutes in his specimens with
large numbers fall pretty regularly into one of the normal series ; in my
specimen with 20 scutes there are at least 2 anomalous scutes, one of which,
cut out of the median portion of the 12th left marginal, is exceedingly small.

[2] Of 24 of his turtles (museum specimens), the geographic origin is not
indicated ; 43 are Pacific and Indian, 6 Atlantic, and 3 Mediterranean.   If
all the specimens of doubtful origin are from the Atlantic ocean, there
would still be a similar though not quite so great difference between the
two lots—Pacific and Indian on the one hand, Atlantic on the other.

[3] Some herpetologists have regarded as different species the Logger-Sea
Turtles of the Pacific and Indian oceans, on the one hand, and those of the
Atlantic and Mediterranean on the other (Agassiz in "The Natural His-
tory of the United States," Part II, 1857, p. 384 ; Garman in "Natural His-
tory of the Bermudas ;" Bull. No. 25 of U. S. Nat'l Mus., Vol. I, 1884,
pp. 300, 301, etc.).   By Garman the specific name *olivacea* is used for Pa-
cific and Indian forms.   Gadow, however, includes all in one species, *T.
caretta* (Camb. Nat'l Hist., Vol. VIII, 1901, p. 387).

ently much more abundant there, relatively, than in the same
species in Maryland and North Carolina.[1] It would appear,
therefore, that the diversity in Texas terrapins presents a different
aspect from that of the diversity in North Carolina forms. Per-
haps the same types will be found in both regions, but the
relative abundance of different types may be quite different in
the two regions.

The remarkable number of abnormalities noted in *Malaclemmys*
lead me to make, for comparison, a few observations on other
species, and a summary of these observations is pertinent in this
connection.

Other Species.

Through the courtesy of Dr. Leon Stejneger, I was enabled
to make the observations on *Chelone* and *Eretmochelys* from
specimens in the United States National Museum. 31 specimens
of the green turtle, *Chelone mydas*, all new-born and from James
Island of the Galapagos Group, were observed. 9 specimens
possessed supernumerary scutes in the carapace, and others had
irregularities in the plastron. An interesting feature of the
abnormalities in these is the recurrence of a few types—super-
numerary neural between 4th and 5th neurals (3 cases), paired
nuchals (3 cases) ; also the instances of partial division of scutes :
last neural (3 cases), 4th costal (2 cases), 5th costal (1 case—
and this scute is once represented by a pair of scutes), *gular* of
plastron (9 cases—and this scute is in 6 instances represented
by a pair of scutes). We are entirely without grounds for sup-
posing that these instances of partial division have any different

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[1] This sentence was based on a statement made to me by Professor Hay.
Since this paper has gone to press, I have received a copy of his paper of
recent appearance : " A Revision of Malaclemmys, a Genus of Turtles."
(Bull. of the Bureau of Fisheries for 1904. Vol. xxiv. Pages 1 to 20.
Plates I to xii.) In this paper the Texas forms are placed in a distinct and
new species, *Malaclemmys littoralis* Hay. He says in regard to them : " A
very interesting malformation, consisting in the longitudinal division of one
or more of the vertebral plates, was observed in many individuals of this
species, a condition so common that it was really difficult to pick out a full-
grown specimen which did not show it in some degree." (P. 19.)

explanation from that of the cases of complete division (*i. e.*, separate scutes) which we note in very young embryos and in large adults of *Thalassochelys* and *Malaclemmys*. Whatever may be the factors that determine the diverse arrangement of scutes by the diverse disposition of sutures, we have no reason to assume that they are not just as competent to produce incomplete as complete sutures. On the contrary, we have seen that in *Malaclemmys* incomplete sutures may be produced. The obliteration of a suture once formed is an entirely different proposition, for which evidence is as yet lacking.

The interesting point is, that the diversity in these turtlets of a different species and from a different geographic region (from the lots previously considered), presents a somewhat new aspect.

In 12 new-born "tortoise-shell" turtles, *Eretmochelys imbricata*, from Apalachicola, Florida, no supernumerary scutes were found.

Only one of eighteen adult specimens of the common speckled tortoise, *Clemmys guttatus*, from Beaufort, N. C., showed a supernumerary scute in the carapace (in posterior region, perhaps a neural).

No supernumerary scutes were observed in the carapaces of 15 adult specimens of the mud tortoise, *Kinosternon pennsylvanicum*, from Beaufort, N. C.

The facts here given may sometime be of use to someone who can throw more light on the question how far distinct species, or the same species in different geographic regions, may differ—in the abundance of abnormalities, in the degree of the abnormalities, and in the relative abundance of the different types of abnormality.

THE TENTACLE REFLEX IN A HOLOTHURIAN, CUCUMARIA PULCHERRIMA.

By Caswell Grave.

The observations recorded in this paper were made at the Fisheries Laboratory at Beaufort, North Carolina, and at the Johns Hopkins University, on young specimens of a holothurian

(Cucumaria pulcherrima), reared from eggs and larvae captured by towing ; on small specimens which chanced to be brought into the laboratory with other material ; and on the adult animals. Interest attaches to the observations because of the meagreness of our knowledge of the instincts and reflexes exhibited by invertebrate animals.

By the tentacle reflex in holothurians is meant the contraction of the oral tentacles which takes place when the animals are disturbed and the invagination of these organs within the atrial chamber.

The species of holothurian under discussion, while not abundant in Beaufort Harbor, is not an uncommon form. Its most usual habitat is the muddy bottoms which have become overgrown with eel-grass, where it can be collected at low tide by digging. The solitary individuals live within vertical " U "-shaped burrows above which, when the animals are not disturbed, their oral and anal ends project. If startled, the water contained within their respiratory trees is expelled, their oral and anal ends are completely infolded, and the animals thus withdraw into their burrows until the danger is past. When collected and placed in aquaria containing a layer of sand, the animals soon (10 to 30 minutes) expand their anal ends and begin the respiratory process which consists in periodically taking water slowly into the respiratory trees through the cloaca and forcibly expelling it through the same opening. The oral end, on the other hand, is unfolded with the greatest caution. Animals kept captive for several hours in a perfectly quiet place often expand their tentacles but immediately retract them upon the slightest jar to the aquarium.

The value of this delicate reflex to the animals is evident. Without it the long branched tentacles which, when in use, are extended beyond the mouth of the burrow to half the length of the body of the animal, would be nipped away by the fishes and crabs on the lookout for food, for in the tentacles the hard calcareous skeleton which renders distasteful the holothurial body as a whole, is very feebly developed.

The habit of withdrawing the tentacles and tube feet within

the body upon external stimulation is very early developed and it may be said to be instinctive. The perfectly developed reflex is exhibited in the free-swimming larvæ at a stage in which there are but five unbranched tentacles and two tube feet. Such larvæ cannot be handled without causing a contraction of the tentacles and tube feet but they are far less cautious than adults in expanding these organs again when the stimulation has ceased. A number of larvæ in this stage, taking by towing in 1902, were placed in an aquarium stocked with sand and diatoms. At the end of the season they were removed to Baltimore and kept under observation until the following summer. The aquarium containing the holothurians was kept on a work table before a window and at almost any time the animals might be seen feeding upon the diatoms which grew upon the surface of the sand and sides of the aquarium.

During the coldest weather of the winter the holothurians withdraw their tentacles and remained in one position with their whole bodies much contracted. Other short periods were also noted during which feeding did not go on, when the tentacles were not to be seen.

In May when the animals were transferred to a smaller aquarium in order more easily to transport them to the sea shore, it was necessary to remove each animal forcibly from the bottom and during the process many of the tube feet were torn in two. During and immediately after this rough treatment it was noted that the animals did not retract their oral tentacles and even when removed from the water, allowed the tentacles to hang limp from the body. This unusual want of sensitiveness occasioned considerable surprise and subsequently, to further test the observation, the animals were occasionally poked with a glass rod and the tentacles were moved about and pinched with forceps. Their failure to react in the usual way to these stimuli lead to the conclusion that these animals, living under the abnormal conditions of the aquarium, had lost their tentacle reflex.

When the absence of the tentacle reflex was first noted it seemed possible that this might be the normal condition of young specimens, but later the opportunity was afforded to experiment

upon two small wild specimens brought to the laboratory with other material, and in both cases the tentacle reflex was as well developed as in adults.

The aquarium grown holothurians have been transferred from one vessel to another several times during the second and third years of their existence and with each transfer some of their tube feet have been torn off. Under this rough treatment the use of the reflex has been gradually regained and now when the animals are touched while feeding the tentacles are withdrawn but the retraction is slow and they are otherwise not so sensitive as wild specimens.

From these observations it is possible to conclude that the tentacle reflex in holothurians is at first an instinctive action but, in the absence of constant stimulation and use, it rapidly loses its efficiency. In my aquaria in which no enemies to the holothurians existed and in which disturbances to the animals never resulted in injury to their tentacles, the reflex was never called into action and its use was gradually lost. That the mechanism by which it acts still existed is shown by the fact that under the stimulus of cold the tentacles were retracted and at other times, apparently under no special stimulus, the tentacles were withdrawn.

Memoirs from the Biological Laboratory of the Johns Hopkins University.

Edited by Professor WILLIAM K. BROOKS, Ph. D.

NOTES IN BOTANY.

Edited by Dr. DUNCAN S. JOHNSON,

Associate Professor of Botany.

SEED DEVELOPMENT IN THE PIPERALES AND ITS BEARING ON THE RELATIONSHIP OF THE ORDER.[1]

BY DUNCAN S. JOHNSON.

The work of Professor Campbell on Peperomia, and that of the writer on Piper, Heckeria and the genus Saururus have shown that in the Order Piperales a considerable variety is displayed in the mode of development of the embryo-sac, endosperm and embryo.   In the hope of finding some type of development that would throw light on the meaning of these peculiarities and their relation to each other, the writer has recently studied the development of the genera Anemiopsis and Houttuynia, of the family Saururaceae, and representative genera also of the Chloranthaceae and Lacistemaceae, the two remaining families of the Piperales.

The result thus far has been not the discovery of any type of embryo-sac intermediate between the peculiar one of Peperomia and that found in the other Angiosperms, but rather an additional confirmation of the conclusion reached by Hofmeister, Strasburger and Hegelmaier, that the structure and mode of development of the megaspore and gametophyte of the Angiosperms is not a satisfactory index of genetic relationship, since these features of development may vary widely even within the limits of a single family or genus.

Among the Piperaceae, for example, we find in the genus Piper a typical seven-nucleate embryo-sac, in which endosperm

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[1] Work on the development of the Piperales is being continued by the aid of a grant from the Botanical Society of America.   Detailed results, with illustrations, will be published later.

is developed in what we are wont to call the typical manner, that
is by the division of the endosperm nucleus into many free nuclei
lying in the peripheral layer of cytoplasm in the embryo-sac.
The closely related genus Heckeria is identical with Piper except
that cell walls immediately follow the division of the endosperm
nucleus from the first division on, that is, the endosperm is cellular
from the beginning.

In Peperomia we have the widest deviation in the development
of the embryo-sac known.   It is at first sixteen-nucleate, then
when ripe it has an egg, and an endosperm nucleus formed by
the fusion of eight of the sixteen nuclei.   The remaining seven
nuclei are peripheral in position, and one of the latter is found
near the egg in the position of a synergid in the typical embryo-
sac.   The endosperm of Peperomia is cellular from the start, as
in Heckeria.   In all of these Piperaceae but a single megaspore
is formed, and the tapetum is persistent even to the ripe seed.

In the Saururaceae, on the other hand, the functional megas-
pore is one out of two potential megaspores in Anemiopsis, and
one out of three in Houttuynia and Saururus.   A tapetum is
formed and is persistent in Anemiopsis and Saururus, but it is
wanting entirely in Houttuynia.   The mature embryo-sac is a
typical seven-nucleate one, but the endosperm develops in a
manner peculiar to these and to certain other genera in widely
separated families.   The first division of the endosperm nucleus
is followed by a cell wall cutting the embryo-sac into an upper
and lower cell, only one of which divides further.   In the Sauru-
raceae it is the upper one of these two primary cells that divides
further to form a considerable mass of endosperm.   The lower
cell forms an elongated flask-shaped haustorium with but a single
nucleus.

In *Lacistema myricoides*, a representative of the only genus
of the Lacistemaceae, we find a single archesporial cell in the
ovule, and this gives rise to probably three potential megaspores.
One of these develops to a typical seven-nucleate embryo sac, in
which endosperm development begins by the formation of a large
number of free nuclei scattered in a peripheral layer of cytoplasm.

In *Hedyosmum nutans*, which was taken as an example of the

Chloranthaceae, there is a single archesporial cell and a persistent tapetum. From one of three potential megaspores a seven-nucleate embryo-sac is formed in which the endosperm is cellular from the outset of its development.

A glance over the facts recorded above shows that, even if we leave out of account the last two families as of uncertain relationship, we still have in the remaining six genera a variety in the development of the tapetum, megaspore, embryo-sac and endosperm nearly as great as can be found in the whole group of Angiosperms. The tapetum may be wanting or may be present and persistent. There may be one, two or three potential megaspores, the other known types among Angiosperms being those in which four megaspores are formed from a single archesporial cell or several from several archesporial cells. Two types of embryo sac development and structure are found here, Casuarina perhaps showing the only other type among Angiosperms. In endosperm formation we find all three of the types commonly found among Angiosperms.

The facts here noted seem to me to furnish no important evidence for or against the affiliation of the Chloranthaceae and Lacistemaceae with the Piperales, which is assigned them by Engler. On the other hand, the complete replacement of nucellar tissue by endosperm is a feature of seed development which is more constant throughout large groups than most, or perhaps any, of the characters mentioned above. The presence of the latter type of seed structure in both Hedyosmum and Lacistema, and also the well-developed embryo of the latter, contrast markedly with the abundant perisperm, the slight endosperm and small embryo of the Piperaceae and Saururaceae. On these grounds, and because also of certain peculiarities of placentation and flower structure, I am not inclined to think the Chloranthaceae and Lacistemaceae closely related to the rest of the Piperales.

The development of the seed gives some facts worth considering as evidence of the relationship of the Piperaceae and Saururaceae to the other orders of Dicotyledons.

In the first place, one of the types of endosperm formation occurring in these families, that by direct cell formation in the

whole or half of the embryo-sac, is one which occurs else-where among Dicotyledons only in highly specialized forms. These are chiefly aquatic, parasitic or saprophytic forms, and include one or several genera of each of the following families : Loranthaceae, Balanophoraceae, Aristolochiaceae, Nymphaeaceae, Labiatae, Scrophulariaceae, Plantaginaceae, Campanulaceae and several others. These families are found almost entirely in the higher orders of the Archichlamydeae and Metachlamydeae, according to Engler's arrangement.

Secondly, the storage of food material in the tissue of the megasporangium is a feature not found in any Pteridophyte or Gymnosperm, and occurs among Monocotyledons only in the highly specialized Scitamineae. Among other Dicotyledons also, perisperm is found only in a series of four orders, the Aristolo-chiales, Polygonales, Centrospermae and Ranales, all placed by Engler near the middle of the sub-class Archichlamydeae.

Thirdly, the development of the flower, of the male gameto-phyte, and of the seedling present no necessarily primitive characters.

Finally, the peculiar type of embryo sac found in Peperomia is most nearly approached elsewhere by the probably independ-ently-developed one of Gunnera. This genus is placed by Engler in the Myrtiflorae, near the top of the Archichlamydeae.

All of the above facts seem to me to indicate that the Piperales are not very primitive Angiosperms, and while I am not prepared definitely to establish their relationship I am inclined to look upon the other four orders of Dicotyledons with perisperm-con-taining seeds as their nearest allies.

THE DEVELOPMENT OF SARRACENIA PURPUREA L.

BY FORREST SHREVE.

The flower of *Sarracenia purpurea* is axillary and borne singly upon a scape from 2.5 to 5 dm. in length ; it is perfect, hypo-gynous and radially symmetrical, with the members of each floral whorl cyclic in arrangement. The stamens arise as ten

groups of primordia, each with a common base. The ovary, which is pentagonal in outline throughout development, arises from the fusion of five carpellary outgrowths so situated as to form the corners of the ovary. The stigma, which in the mature flower resembles a raised umbrella, is formed by the continued growth of the carpels in an upward and later an outward direction. The placentae grow from the middle of each of the sides of the ovary, being therefore the edges of the carpels. They eventually become T-shaped in cross section with the arms of the adjoining placentae directed back into the corners of the ovary by their mutual pressure.

The archesporium of the microsporangia is massive, the number of microsporangia, four. The sporogenous tissue passes the winter in the mother-cell stage. A tapetum two layers in thickness is developed from the archesporium ; the number of parietal layers is approximately five, the endothecium is, as usual, differentiated as a mechanical layer for the opening of the anthers, which takes place by means of two slits so situated that each opens the two microsporangia on one side of the connective. The tetrad division of the microspore mother-cells is simultaneous ; at the first division the reduced number of chromosomes may be ascertained to be 12, which are short and stout in form. The pollen grains possess the characteristic coats, and the nucleus divides into tube and generative nuclei before shedding.

The ovules make their appearance as protuberances on the placentae at the close of the growing season in the autumn. They make no growth however until the spring. The bending of the ovule which is to render it anatropous begins at once, and there may then be seen the single archesporial cell, which is the megaspore mother-cell. There is no tapetal cell. The integument is single and grows at such a rate as to have covered the tip of the nucellus by the time of the maturation of the megaspore mother-cell. The maturation is of such a type as to give rise to a linear series of four megaspores, of which the chalazal one is functional. In many cases the micropylar daughter-cell of the first division does not divide, and in a few cases it divides transversely to the length of the ovule. The single layer of the

nucellus surrounding the micropylar end of the definitive megaspore is at this time absorbed, so that the megaspore comes to lie directly against the integument. The embryo-sac develops by three successive nuclear divisions to the eight-celled form which is characteristic of the majority of Angiosperms. The polar nuclei meet and fuse in the centre of the sac. The antipodals are early pushed to one side by the downward growth of the base of the sac between the integument and the lower part of the nucellus.

The stigmatic surfaces of the style of Sarracenia are on papillae of which there is one on the under side of each of the five points of the umbrella. Running from the stigmas toward the centre of the umbrella are five heavy veins in which there is a well-defined conducting tissue. In the stalk of the umbrella there runs a small passage connecting the interior of the ovary with the outside air. Running out from the five angles of this passage, in the median line of the carpels, are sheets of thick-walled cells running the entire length of the stylar stalk. A week or more before pollination, these sheets split so as to form canals connecting above with the conductive tissue of the umbrella, and below emptying into the ovary, just above the line of junction of the adjoining placental outgrowths. The pollen-tube passes through the conducting tissue of the umbrella and down the canals in the stalk, which are partly filled by the degeneration of their walls. The generative nucleus has been found to have divided before the tube reaches the centre of the umbrella. The entire course of the tubes is between cells rather than through them, and when they leave the canals and enter the ovary they pass between the closely appressed walls of the adjoining placental outgrowths, entirely outside the tissue.

Fertilization was not found to present any unusual features. The endosperm nucleus divides by a wall transverse to the length of the ovule into cells of equal size, each of which again undergoes division in the same direction several successive times. Just before the completed fusion of the male and female nuclei the endosperm is of from two to eight cells, and while the embryo is yet two-celled the endosperm becomes several hundred

cells in mass. The embryo develops a suspensor of some six or seven cells, the terminal one of which divides laterally and proceeds to the formation of a spherical embryo in a manner which, so far as observed, is like that typical for the Dicotyledoneae. The embryo in the mature seed has developed the cotyledons, and is surrounded by an endosperm richly stored with aleurone. The seed-coat is formed by the thickening of the epidermal cells of the integument, the inner cells of which are crushed to make room for the growth in diameter of the endosperm.

In germination the cotyledons act as haustoria for the removal of the stored food, and survive as simple liguliform leaves bearing chlorophyll. The first epicotyledonary leaf is pitchered and arises from the massive growing-point in a manner which is essentially like that of the leaves of Darlingtonia as described by Goebel (Pflanzenbiologische Schilderungen, II. 5, p. 76 ; pl. XIX.).

NOTES ON THE DEVELOPMENT OF PHYTOLACCA DECANDRA L.

By I. F. LEWIS.

It was suggested by Johnson ('02)[1] that the endosperm persisting in the seeds of certain families, including the Phytolaccaceae, played an important part in germination, serving for the transfer of food material from the perisperm to the developing embryo. The observations here recorded were made with the primary purpose of following the origin and fate of the endosperm in Phytolacca, with special reference to the behavior of the endosperm during germination.

Material was collected on Long Island in August and in North Carolina in September, and fixed in chrom-acetic acid.

The flowers are borne on a long terminal raceme. The flower

[1] Johnson, D. S., On the development of certain Piperaceae. *Bot. Gaz.,* 34 : 1902, pp. 334–335.

rudiment is first seen as a rounded eminence a short distance from the growing point, subtended by a scale-like bract (Fig. 1). On the lateral border of this eminence appear the parts of the flower in strict acropetal succession, the five sepals becoming visible first, followed by the five petals, then the ten stamens, and finally the ten carpels (Fig. 2). After these organs have appeared, a flower stalk is developed by the elongation of the basal portion of the flower rudiment, the stalk of the mature flower reaching a length of a centimeter or more. The further development of sepals and petals offers no striking peculiarity. In material collected in North Carolina, the petals fall away at about the time the flower opens, and are not seen in the fully expanded flower. The petals may be said to be caducous, and not ''wanting,'' as stated in the manuals of Gray and of Britton.

The young carpels arch over the growing point of the flower, and on the border of this growing region appear the ovules, usually ten in number (Fig. 2). Hence the ovules of Phytolacca are cauline in origin.

The development of stamen and microsporangia differs in no marked respect from that usual in Dicotyledons. The formation of archesporial, parietal, tapetal and sporogenous cells is of the usual type. In each of the four microsporangium rudiments in a stamen is seen a single row of hypodermal archesporial cells. Each of these divides into an outer parietal and an inner primary sporogenous cell (Fig. 3). From the latter arise part of the tapetum and the definitive sporogenous tissue. The remainder of the tapetum is furnished by the cells adjacent to the sporogenous cells.

The total number of microspore mother-cells formed is about eighty. After a period of rest, during which the protoplasm of the mother cells is drawn away from the cell walls, the nucleus of each mother-cell divides into two in the usual way. Each of the daughter nuclei divides again immediately. These divisions take place in very rapid succession and in the process no cell plates are formed, so that the four nuclei lie in a homogeneous spherical mass of protoplasm, about which is the gelatinized mother-cell wall. Each nucleus, with the immediately surround-

ing protoplasm, seems to pull away from the other nuclei so that the nucleated mass becomes four lobed. Now the protoplasm becomes divided into two parts, each shaped like a short thick dumb-bell, with a nucleus in each end, and one lying across the other (Fig. 5). Each dumb-bell shaped mass divides into two, so that four masses of protoplasm, each with its nucleus, become completely separated from one another without the intervention of middle lamellae or cell walls. It is to be noted that the protoplasmic divisions follow the same sequence as the nuclear divisions, the protoplasm dividing first into two, then into four parts.

The microspores thus formed become surrounded with intine and exine in the usual way. When the pollen is shed, the division of the microspore nucleus into tube and generative nuclei has already taken place.
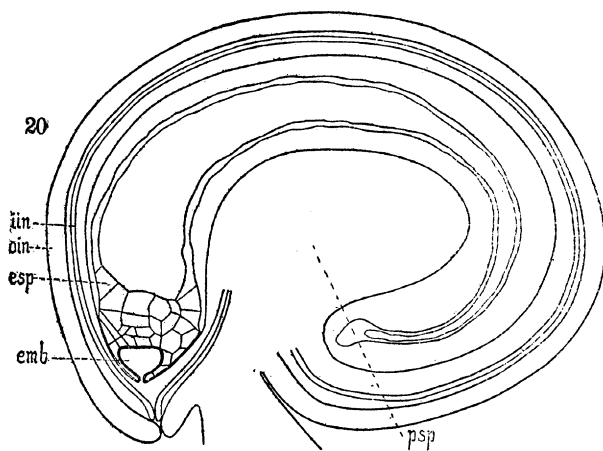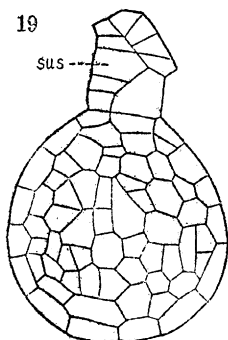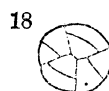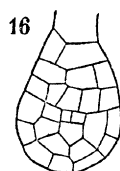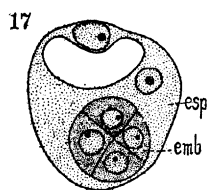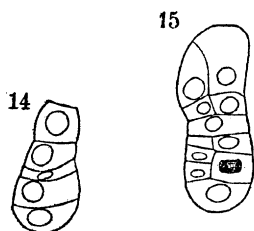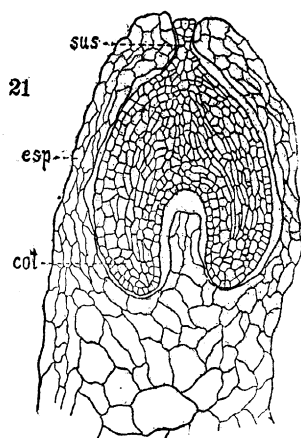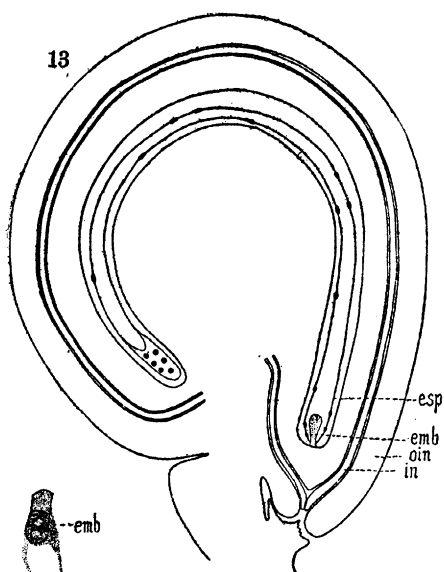
The nuclei in the tapetal cells divide amitotically, giving rise to as many as six nuclei within one protoplast. The average number is four.

At about the time the microspore mother-cells are formed in the stamens, one of the hypodermal cells near the apex of the ovule becomes distinguishable by its darkly staining contents and slightly enlarged nucleus. This primary archesporial cell divides periclinally into an inner megaspore mother-cell and an outer tapetal cell (Fig. 6). Not rarely two primary archesporial cells are differentiated (Fig. 7), each giving rise to a tapetal cell and a megaspore mother-cell. When this is the case, apparently only one mother-cell develops further, since not more than one has been seen at any stage later than this. The two integuments first appear at about the time of the division of the archesporial cell into tapetal and megaspore mother-cells (Fig. 6).

The megaspore mother-cell enlarges considerably, and the nucleus goes into the characteristic synopsis stage (Fig. 8). The divisions from this point to the development of the embryo-sac were not followed.

The ovule at maturity is campylotropous, with the two integuments well developed. Around the base of the funiculus is a ring of glandular hairs, formed from the epidermal cells of the base of the funiculus and the immediately adjoining carpellary wall (Fig. 9).

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I.F.Lewis del.

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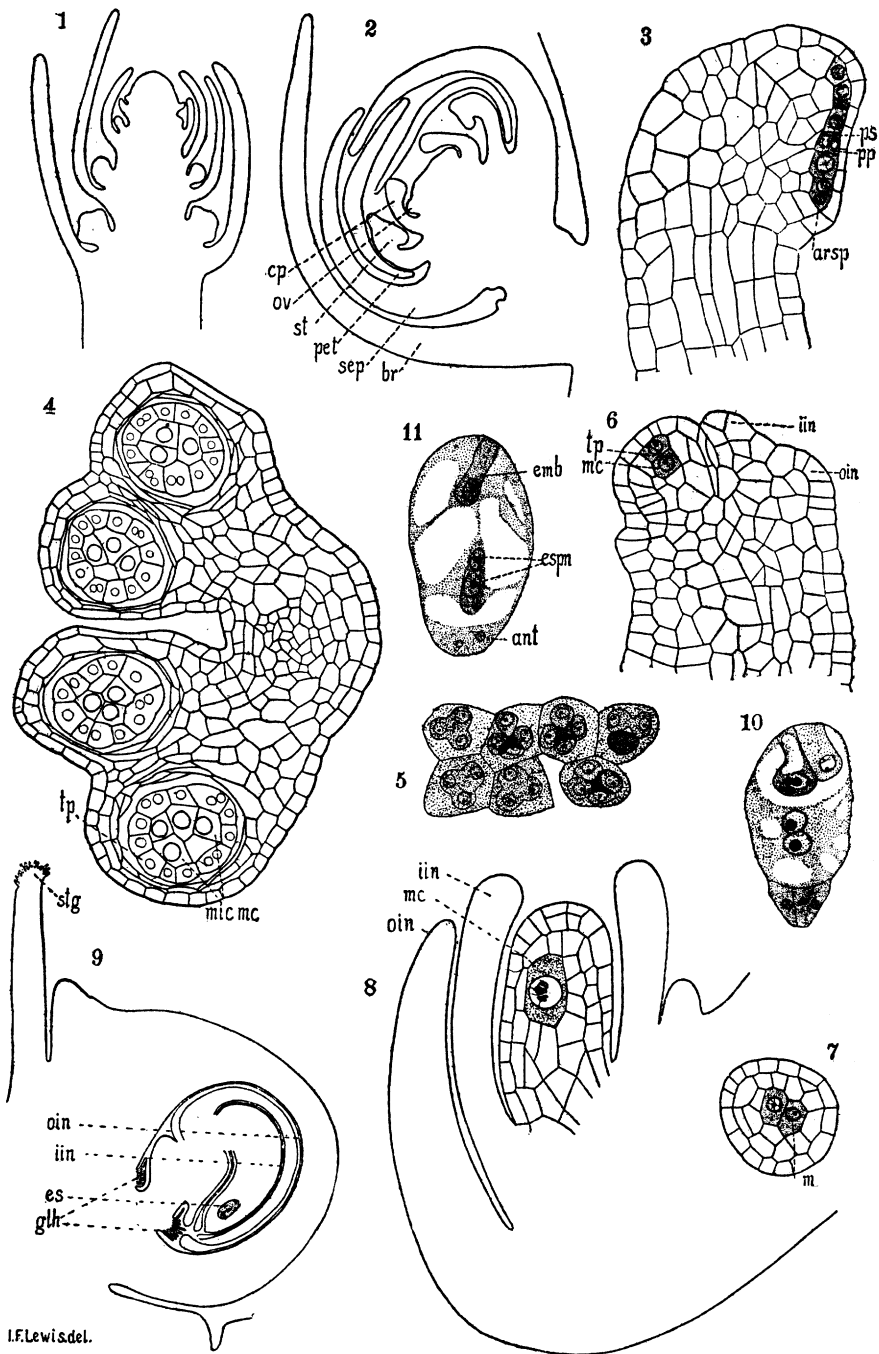
I.F.Lewis.del.

The embryo sac presents the usual appearance, with the antipodals weakly developed, and the polar nuclei conspicuous. The region around the polar nuclei becomes packed with food granules, and at the time of fertilization the egg also is dense with food material (Fig. 10).

At the time when fertilization occurs, the polar nuclei fuse to form the endosperm nucleus. The endosperm thus initiated grows rapidly at the expense of the nucellar tissue, forming a sac with a great central vacuole. The peripheral protoplasm is thin, except at the chalazal end of the sac, where it is massed and dense (Figs. 11, 12). The nuclei lie free in the protoplasm of the endosperm, and divide always amitotically. The sac continues to push its way into the nucellus until it reaches almost to the chalazal end of the seed. It forms an extensive curved cavity into which the embryo is to grow (Fig. 13). At about the time the cotyledons of the embryo first appear, the endosperm in the micropylar region becomes cellular, walls appearing between the nuclei. The cells thus formed are large, and have a scanty amount of protoplasm. With the formation of cell walls, the endosperm increases in actual volume and begins to fill in the large central cavity (Fig. 20). The cell walls gradually extend to the chalazal end of the embryo-sac, so that the endosperm becomes completely cellular, except for the mass of protoplasm already mentioned as lying at its chalazal end. By the time the cotyledons are well differentiated, the endosperm has increased in volume until the central cavity is almost, if not quite, obliterated (Fig. 21).

The growth of the embryo is at first very slow, and the endosperm sac has attained its full length before the cotyledons appear. The first divisions of the egg are transverse (Figs. 12, 15). When the embryo consists of four or five cells, median vertical walls appear in the upper cells, forming usually three tiers of quadrants, from which arises the embryo proper (Figs. 16, 17). The next few divisions follow two lines. In the two quadrants opposite each other, periclinal vertical walls appear, and in the remaining pair of quadrants the divisions are obliquely anticlinal and vertical (Fig. 18). The succeeding divisions restore the

symmetry of the cross section, being anticlinal in the first pair of quadrants, and periclinal in the second. This sequence of divisions was found in the sections examined. How far it may generally hold good cannot now be stated positively.

At a slightly later stage the embryo shows a well developed suspensor and a spherical embryo (Fig. 19). The suspensor is formed at first of two or three cells, and later divisions increase this number considerably. The cotyledons appear as swellings on the sides of the stem end of the embryo, the stem growing-point lying between them (Fg. 22). One of the cotyledons lies on the side toward the funiculus, the other opposite it, so that plane of flattening of the seed passes through both cotyledons. The growth of the embryo from this point is very rapid. At the time the embryo has attained its full length, it is completely surrounded by several layers of endosperm cells, which have dissolved away the nucellus about the whole periphery of the seed. The nucellar tissue of the central portion of the flattened seed persists to form the perisperm (Fig. 23).

The perisperm begins to be differentiated shortly after the appearance of the cotyledons of the embryo. There becomes apparent an accumulation of starch in that part of the nucellus lying in the concavity of the curved embryo. This accumulation increases until the large cells become densely stored with food material.

After attaining its full length, the further growth of the embryo is in thickness. This growth is at the expense of the endosperm, the cells of which become disorganized, giving place to the swelling embryo. This disorganization is complete on the inner side of the embryo, between the embryo and perisperm. On the outer side of the embryo, between it and the inner integument, is seen a single layer of uncrushed endosperm cells, and around the tip of the radicle there remains a sort of cap of several cells in thickness (Figs. 23, 24, 25).

In the mature seed, the outermost layer of the outer integument is greatly thickened and hard. The inner integument is also hardened and shows a cutinized inner surface.

At the time of germination the embryo elongates and the

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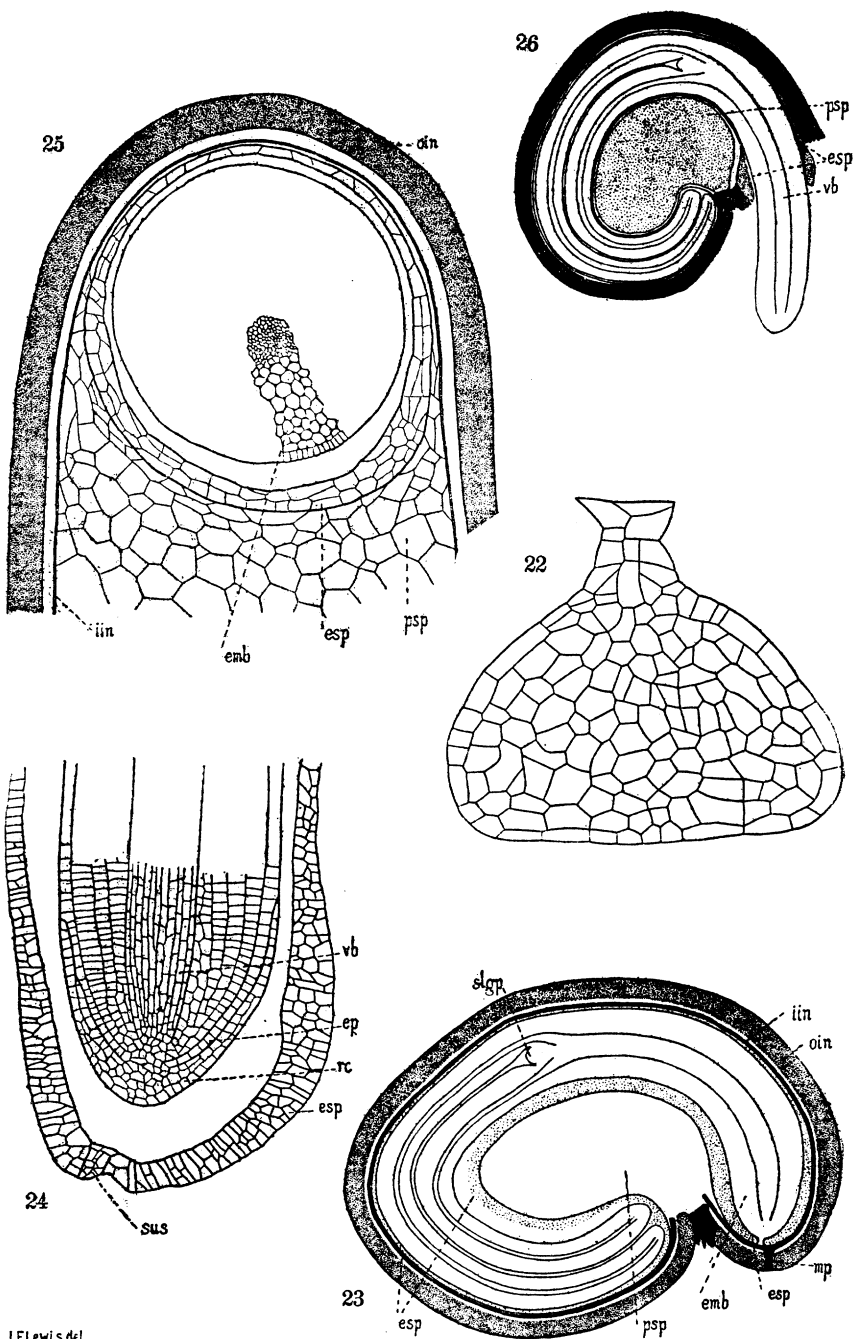
radicle is pushed through the endosperm cap and the seed coat, at the micropyle (Fig. 26). The cotyledons continue to elongate until the stem growing-point is pushed outside the seed. The tips of the cotyledons are separated from the perisperm only by the crushed remains of the endosperm. The cells of the thick endosperm cap remain turgid and persist as a thick ring of tissue clasping the bases of the cotyledons and stopping the opening made in the seed coat at germination.

EXPLANATION OF PLATES.

Abbreviations used: *ant*, antipodal; *arsp*, primary archesporial cell; *br*, subtending bract; *cot*, cotyledon; *cp*, carpel; *em*, embryo; *ep*, epidermis; *es*, embryo sac; *esp*, endosperm; *espn*, endosperm nucleus; *glh*, glandular hairs; *iin*, inner integument; *mc*, megaspore mother-cell; *mic mc*, microspore mother-cell; *mp*, micropyle; *o*, ovum or egg; *oin*, outer integument; *ov*, ovule; *pet*, petal; *pn*, polar nucleus; *pp*, primary parietal cell; *ps*, primary sporogenous cell; *psp*, perisperm; *rc*, root cap; *sep*, sepal; *sg*, synergid; *st*, stamen; *stg*, stigma; *stgp*, stem growing-point; *sus*, suspensor; *tp*, tapetum; *vb.*, vascular bundle tissue.

Fig. 1. Longitudinal section of young raceme. X 15.

Fig. 2. Longitudinal section of young flower. X 20.

Fig. 3. Longitudinal section of a young stamen. X 165.

Fig. 4. Transverse section of an anther; the microspore mother-cells shown. X 100.

Fig. 5. Section showing mode of formation of microspores. X 165.

Fig. 6. Longitudinal section of slightly older ovule at beginning of formation of integuments. X 165.

Fig. 7. Transverse section of same; two megaspore mother cells shown. X 165.

Fig. 8. Longitudinal section of older ovule; the nucleus of the megaspore mother-cell is in synapsis. X 165.

Fig. 9. Longitudinal section of pistil at time when embryo-sac is mature. X 20.

Fig. 10. Longitudinal section of ripe embryo-sac; only one synergid is represented. X 165.

Fig. 11. Longitudinal section of embryo-sac after fertilization; two endosperm nuclei shown. X 165.

Fig. 12. Similar section; showing three celled embryo and growing endosperm sac. X 70.

Fig. 13. Longitudinal section of young seed. X 20.

Fig. 14. Longitudinal section of embryo of same age as that shown in Fig. 13. X 165.

Fig. 15. Longitudinal section of five celled embryo. X 165.

Fig. 16. Similar section of slightly older embryo. X 330.

Fig. 17. Transverse section of embryo of same age as that shown in Fig. 16, surrounded by endosperm. X 165.

Fig. 18. Transverse section of embryo of same age as that shown in Fig. 14. X 165.

Fig. 19. Longitudinal section of older embryo. X 165.

Fig. 20. Longitudinal section of young seed; embryo of same age as that shown in Fig. 22. X 15.

Fig. 21. Longitudinal section of older embryo and part of endosperm. X 85.

Fig. 22. Longitudinal section of older embryo; cotyledons just becoming visible. X 165.

Fig. 23. Longitudinal section of nearly ripe seed; embryo is completely surrounded by endosperm. X 13.

Fig. 24. Longitudinal section of tip of radicle with surrounding endosperm from an older embryo than that shown in Fig. 26. X 40.

Fig. 25. Transverse section of radicle of nearly mature seed with surrounding tissues. X 40.

Fig. 26. Longitudinal section of germinating seed. X 8.

ERRATUM.

The actual magnifications are twice as great as the figures given in the Explanation of Plates, except in Figure 16, where the magnification given is correct.

NOTES IN HISTORY.

Edited by Dr. JOHN M. VINCENT,

Associate Professor of History.

[Abstracts of papers read before the Historical and Political Science Association.]

SLAVERY IN THE BAHAMA ISLANDS.

BY J. M. WRIGHT.

The author was a member of the expedition sent out by the Geographical Society of Baltimore to study the natural conditions of that colony. He spent three months in a careful examination of the archives of the colonial government, and the present paper is a portion of the results of his research. The history of the Bahamas has been almost entirely neglected. Except for a few pamphlets and short sketches in books of history and travel there has been nothing published on the subject. The materials lie for the most part in the archives of Nassau. The chief sources are the journals of the House of Assembly ; the journals of the Council (on the legislative side) ; the despatches of the British Secretaries of State to the colonial governors ; the despatches of the governors to the home government ; miscellaneous letters of the governors ; the Royal Gazette (a newspaper published at Nassau) ; the session papers of the British Parliament, particularly those relating to slavery, abolition, the land system and apprenticeship.

The movements for the abolition of the slave trade, for the amelioration of the condition of the slaves, and finally the entire abolition of slavery placed the inhabitants of the Bahamas and the government of England more or less in opposition. The paper shows the method of transition to freedom through servant apprenticeship and land ownership. The history of the relations between England and its West Indian possessions is instructive to students of colonial administration. The author is at present in the Bahamas continuing his researches on behalf of the Carnegie Institution.

JUSTICE IN COLONIAL VIRGINIA.

BY O. P. CHITWOOD.

The judiciary was in all its branches closely allied to the other departments of the government. Prior to 1682, the assembly was the highest court of appeal in the colony, and it was closely connected with both the superior and inferior courts during the entire colonial period. Next to the assembly in the order of jurisdiction came the quarter or General Court, which was composed of the governor and his council. The most important inferior court was the monthly or county court whose judges were justices of the peace, commissioned by the governor. The judges of the General Court constituted the upper house of the assembly, and the justices of the county courts were often elected to seats in the lower house. Besides, the judges of the General Court, as members of the governor's council, performed executive duties for the colony at large, and the justices of the county courts performed administrative duties in their respective counties.

The judiciary was aristocratic in its organization, and from 1682 to the revolution the people had no voice, either direct or indirect, in the choice of their judges. Even prior to 1682, the assembly was the only court in which judges were elected directly by the people. During the commonwealth period, the judges of the General Court were chosen by the representatives of the people, and for a short while during this period justices of the county courts were appointed with the consent of the assembly. But with these exceptions, the colonial judiciary was thoroughly aristocratic in all its branches.

The position of judge in both the superior and inferior courts was one of honor and dignity, and was usually held by men of ability. The judges of the General Court were very influential in the colony, and were often able to curb the power of the governor. Their opposition to the king's representative probably contributed much toward keeping the colony from falling into a state of close dependence upon the crown. It is also not improbable that out of this opposition to the governor there grew up

that spirit of resistance to the crown which both aristocracy and the people showed in the revolutionary period.

The courts were bound in their decisions by the common law of England, the parliamentary statutes passed prior to 1607, and by the statutes enacted by the Virginia Assembly. But a legal education was not a requisite qualification for judges, and apparently many, if not most, of the judges both of the superior and inferior courts, came to the bench without special training. Therefore, in arriving at decisions, they frequently had to rely, especially in the early years, on their own judgment for guidance more than on law and precedents.

In the documents that have been examined very few complaints against the inferior courts are recorded, and it seems that these courts as a rule administered justice fairly and impartially. There were certain latent weaknesses in the constitution of the General Court which occasionally gave rise to abuses in actual practice. But as only a few cases of such abuses have been found, it may safely be inferred that justice was as a rule fairly administered by the superior, as well as the inferior, courts.

The materials for this study are found in the laws of Virginia, the contemporary accounts of the colonists and various other printed sources, but much valuable information is found in the manuscript records of the county courts, the General Court, the proceedings of the governor's council, and other similar unpublished documents, for the most part in the State Library and the Virginia Historical Society at Richmond.

STATE GOVERNMENT IN MARYLAND, 1777–1781.

By B. W. Bond, Jr.

The printed Archives of Maryland afford material which has not hitherto been utilized for this period. The manuscript collections of the Maryland Historical Society contain also valuable correspondence, both official and private, relating to the conduct of the war and to conditions in the state. Manuscripts in the

Maryland Land Office and in the Library of Congress have also been drawn upon in this research, the conclusions of which may be summarized as follows :

From the inauguration of the State Government, February 5, 1777, to the final ratification of the Articles of Confederation, March 1, 1781, Maryland was an independent state entering into the deliberations of Congress as a sovereign ally. This position was maintained especially in the following incidents :

Interference by Congress in the internal administration was not tolerated. The convention repudiated the arbitrary decree for arresting Governor Eden, and the assembly severely reprimanded two continental officers, Captain Nicholson and Major Lee, for violating the rights of private citizens. As one of the allied states, Maryland preserved this attitude in dealing with Congress. The assembly upheld the refusal of the convention to define exactly the powers of Congress. The result was the failure to ratify the Articles of Confederation without some guarantee for mutual ownership of the western lands. The claim that the title to the back lands, the property of the British Crown, reverted to Congress apparently entailed a corresponding admission of continental sovereignty. As otherwise the attitude of the state points to an opposite conclusion, this particular argument seems to have been employed only to gain the end in view. Congress merely ''recommended'' measures to the states. Certainly in Maryland these resolutions were imperative unless approved by the assembly, or by the governor and council. Both Pulaski and Armand, even when under the special protection of Congress, failed to receive permission to recruit in Maryland. The attempts to impose local regulations upon the Maryland line almost led to many resignations. Coercion in the form of drafts for overdue taxes was quickly resented.

The support accorded conventions to regulate the confused conditions of interstate commerce virtually disclaimed the authority of Congress over such matters. A proposal was made in like manner to settle a boundary dispute with Virginia. The treaty-making power was delegated to Congress, not absolutely, but subject to the approval of the assembly. On the immigration

laws and in the imposition of duties the authority of Congress was not involved, but these ordinarily sovereign prerogatives were exercised solely with regard to the interests of Maryland. In Maryland, therefore, before the ratification of the Articles of Confederation the sovereignty which the British Crown had possessed reverted to the state government. In this particular state, Congress assumed such power only with the express approval of the legislative authority. This conclusion agrees with the doctrine advanced by the advocates of state sovereignty.

SECESSION IN NORTH CAROLINA.

By H. M. WAGSTAFF.

No adequate account of the secession movement in North Carolina has hitherto appeared. The information for this study is found, for the most part, in the newspapers of the time, in the manuscript letter-books of the governors, the manuscript files of the State Council, the letters of Vance and others, published addresses of T. L. Clingman, the printed journals of the assembly, and convention journals. Personal evidence of men now living who were prominent during the period has also greatly aided the inquiry. New light has been thrown upon the period and the results may be summarized as follows :

With the overthrow of the national whig party just after the Compromise Measures of 1850, were enacted into law, North Carolina passed from a whig régime of fifteen years' duration and became democratic in both her national and state politics. Slavery agitation incident to the compromise was influential in her return to particularism, but the immediate cause of democratic ascendency was the blow dealt to whig solidarity by a suffrage reform movement of the democrats begun in 1848. Eastern whigs were favorable to the measure while western whigs desired a more sweeping reform involving the change from the federal to a white basis of representation in the General Assembly.

The whigs thus divided, the democrats elected David Settle

Reid as governor in 1858. Reid was a strict constructionist of the radical school. For several years, however, the assembly, though democratic, refused to sanction a truculent attitude toward congressional legislation on slavery.

With the passage of the Kansas-Nebraska Bill in 1854, disintegration of the state whig party was complete. The "know-nothing" party served as a temporary shelter for the whigs until the Kansas-Nebraska Act had completed the sectionalization of the democrats.

Actuated by a fear of the danger of particularism to the Union, the people of North Carolina began a return in 1858 to the conservative principles which had been abandoned during the excitement of the Kansas struggle. This movement rapidly developed strength and continued its course despite the agitation renewed afresh by John Brown's raid and the stubborn speakership contest in congress. The electoral vote of the state went to Breckenridge, democrat, rather than to Bell, unionist, because the people believed Bell had no chance of election and that Breckenridge's success would furnish the only guarantee of the cotton states remaining in the Union.

Breckenridge's defeat and the subsequent secession of the cotton states divided the people into union and disunion parties. Two theories of the federal constitution were held in the state. (1) The national theory had the adherence of a large portion of the old whigs and their best known leaders. (2) The compact theory was held by the whole body of democrats and a few whigs. Among the democrats, however, were two factions. One faction demanded immediate secession ; the other opposed secession until the rights of the South should be more specifically attacked. This conservative faction acted with the national theory whigs and made up a majority which held the state quiescent and awaiting further development in the national situation.

Despite the formation of the confederate government by the lower southern states, the people of North Carolina voted down a convention to consider secession and the unionists remained dominant until the attack on Fort Sumter. With Lincoln's call

for troops the conservative democrats joined the original secession faction and made a majority for secession. The national theory men were now also prepared to withdraw from the Union, but preferred to do so under the form of revolution. A second convention was called without its reference to the people. This convention met May 20, and was found to contain secessionists and revolutionists respectively in the ratio of two to one. After the test vote the ordinance of secession was passed unanimously. Secession had become an accomplished fact, but only after every effort to remain with honor in the Union had failed.

PARTIES IN THE VIRGINIA CONVENTION IN 1861.

By D. S. Freeman.

This investigation is based upon the printed journals ; contemporary periodicals and pamphlets ; the manuscript Archives of Virginia ; personal interviews with surviving members of the convention ; and manuscript memoirs from many sections of the state. The presence of three different parties in the state when the members of the convention were elected led to the formation of three parties in that body, which did not follow the regular national party lines. The secessionists as their name implies advocated separation from the union with various provisos ; the Unionists were for remaining in the Union at any cost, while the third division, or middle men, were convinced that the proper policy was to remain in the Union as long "as is consistent with the honor of the state." It was the final union of the secessionists and middle men on the question of opposition to coercion which brought about secession.

A like number of questions had to be decided by the convention : should the Peace Conference compromise be accepted ; should any plans for border conference or confederacy be accepted ; and should the state permit coercion of the seceded states ? In considering these questions in order, three more or less distinct periods are discernible in the convention. Until the report of

the Peace Conference was made public, many had believed that
some settlement was possible.   A desire to await the outcome of
this body certainly acted as a deterrent on the convention.   Even
the secessionists were willing for the most part to defer action
until the result of the conference was known.   With the return
of the commissioners and the declaration of a number of them
that the conference result was a " hollow sham,'' this hope was
virtually swept away, and, though the Peace Conference proposals
were not formally rejected until March 25, they were but little
considered after Congress declined to take them up.   Following
close upon the inauguration of Lincoln came the report of the
Committee on Federal Relations appointed during the earliest
days of the convention.   The report was timed to alleviate the
uneasiness occasioned by Lincoln's inaugural, but as it was the
result of endless compromises and gave rise to several minority
reports, it was attacked from all sides.   For the most part the
middle men and some of the Unionists favored this report, but it
was opposed vigorously by the extremists of both sides.   Much
amended, and attacked at every step, it was passed section by
section until the change of front of some of the middle men intro-
duced the third period.   This change was due to a dissatisfaction
with the delay of the convention, a dissatisfaction largely strength-
ened by the sentiment of a great part of the state, and secondly,
by the growing predominance of the issue of coercion.   On April
6, W. B. Preston, an erstwhile strong Unionist, proposed that a
committee wait on President Lincoln to see if he still was firm on
the question of coercion.   The Union party exhausted every effort
in attempting to defeat this measure, but supported by many
middle men as well as secessionists its passage followed two days
later.   With this event, and both secessionists and middle men
united against coercion, the outcome was logical.   On the 12th
came the news of the attack on Sumter, three days later the com-
mittee to wait on the President reported, and secession followed
on the 17th.   It will be observed that during the first period,
with maintenance of the union the chief issue, the Union party
was naturally the leader, aided by the support of the middle
men ; during the second period with border state conference and

the report on federal relations the important issue, a division on these questions led to the gradual alienation of the middle men and unionists, and the predominance of the former. With the issue of coercion before them, the middle men were united with the secessionists, bringing about the supremacy of the latter.

DIPLOMATIC RELATIONS OF THE UNITED STATES WITH RUSSIA (1776–1817).

By J. C. Hildt.

This study attempts to give a systematic account of the official relations of Russia and the United States during the formative period of the union. A large amount of matter has been printed in the American State Papers, in Wharton's Revolutionary Diplomatic Correspondence and in the writings of contemporary statesmen. This material has needed careful sifting and the more important part of this research is derived from the manuscript correspondence in the Department of State in Washington.

As early as 1776 Congress thought of sending a minister to Russia, but none was sent until Francis Dana was elected to the post of Minister to Russia, December 19, 1780. The objects of his mission were to secure the acknowledgment of the independence of the United States by the Empress of Russia, the accession of the United States to the maritime confederacy and the negotiation of a treaty of commerce with Russia. Dana's mission was unsuccessful. Congress had instructed him not to make known his mission to the Russian government until Verac, the French Minister at St. Petersburg, should give his consent, or Congress should order him to do so. As Dana's mission was opposed to French policy, Verac objected whenever Dana proposed to make his mission public. Having received an intimation from the Russian government to do so, Dana announced his mission, without, however, consulting Verac. It was then arranged that Dana should be received at the Russian court as soon as the definitive treaty of peace should be signed between

the European powers then at war.   The end of the war between the United States and Great Britain only left the commercial treaty for Dana to negotiate.   Secretary Livingston, however, refused to furnish Dana with the sum of money which it was the custom to distribute among the Russian ministers at the signature of a treaty, informing him at the same time that he had no power to sign a treaty.   Dana, thereupon, returned home without having been received by the Russian government.

In November, 1798, the Russian minister at London proposed to Rufus King, the American minister there, the discussion of a commercial treaty between the United States and Russia ; but when it was known that the United States were going to enter again upon friendly relations with France, the Russian minister refused to carry the negotiation further.

During Jefferson's administration friendly relations between the two countries were cultivated by the American consul at St. Petersburg, Levitt Harris, to whom the Russian chancellor in May, 1808, proposed the negotiation of a convention between their nations with regard to the trade with the natives in the Russian possessions in the northwest coast of America.   In June, a Russian chargé d'affaires was appointed.

In January, 1810, Daschkoff, the Russian chargé in the United States, announced that he was empowered to enter upon the negotiation of a convention with regard to the commerce between the United States and the Russian settlements in the northwest coast of America.   As Daschkoff had not been instructed to state the southern boundary of the Russian possessions, the American government, fearing that complication might arise with respect to the claims of England and Spain in that region, transferred the negotiation to St. Petersburg.   Then the matter was again discussed, but as the United States did not consider that they would gain anything by such a convention, at Russia's proposal the matter was deferred.

Fearing lest the war between the United States and Great Britain would drive the United States into an alliance with Napoleon who was then invading Russia, the Emperor Alexander offered his mediation to the United States, saying that a similar

offer had been made to Great Britain. Forced by the exigencies of the war the President accepted, believing it to be the successful outcome of the policy of cultivating the friendship of Russia. A special mission of three, Gallatin, J. Q. Adams, and Bayard, was appointed to negotiate a treaty of peace with Great Britain under Russian mediation and a treaty of commerce with Russia with special reference to neutral rights. This mission was a failure, as Russia had accomplished the end for which the offer of mediation had been made.

Before the negotiation of the treaty of Ghent, the American peace commission endeavored to persuade the Russian Emperor to interfere in their behalf with the English government. This he refused to do because Great Britain had stated that she would not tolerate the interference of a foreign power in the matter. Before the close of the year 1815, Kosloff, the Russian consul at Philadelphia, was arrested on a criminal charge and thrown into prison for the night. When the case came up for trial it was dismissed on the motion of the defendant that a state court had no jurisdiction over a consul. The dispute over this question disturbed momentarily the friendly relations of the countries, but by January, 1817, William Pinkney, the new American minister, had arrived at St. Petersburg. His instructions sum up the policy of the United States with Russia during the whole of this period,—the maintenance of friendly relations with Russia, the negotiation of a commercial treaty containing a favorable definition of neutral rights, and the limiting of Russian claims on the Pacific coast to the forty-ninth parallel.

ENGLISH ADMINISTRATION UNDER LORD CLARENDON.

BY P. L. KAYE.

Immediately after the Restoration something like a definite colonial policy appeared when in the navigation acts it was announced that henceforth the colonies were to be managed with no reference to their own welfare, but solely as feeders for home

industries. With this end in view a council was appointed, with Lord Clarendon at its head, to take over the administration of all the colonial dependencies belonging to England. In the appointment of this body, known as the Council for Foreign Plantations, the desire was clearly expressed that the management of the colonies should be made more centralized and that they should be brought under one uniform system of government. But this object was soon completely lost sight of. Virtually no progress whatever was made during the ministry of Lord Clarendon toward the introduction of system and efficiency into the administration of the colonies. In this research it has been the aim of the author to point out the manner of, and the reasons for this failure to accomplish what seemed to be so clearly in the mind of the minister at the time of his accession to power.

In the first place, the organization of the council for plantations was exceedingly defective. Not only was it far too large for active service as an administrative body, but by its appointment the management of colonial trade was separated from that of domestic trade at a time when the commercial policy of England was to make colonial enterprises contribute solely to the increase of domestic industry and wealth. The result of this was long and unnecessary delays in the adoption and enforcement of colonial projects which should have received prompt attention. Instead of bringing order and uniformity into colonial affairs, Clarendon, by granting charters so diverse in character as those of New York and Carolina on the one hand and those of Connecticut and Rhode Island on the other, unnecessarily added to the confusion already existing.

The charters of Connecticut and Rhode Island were, from an administrative point of view, serious errors and it is in the explanation of the manner in which they were granted that the view here set forth differs most notably from that commonly held by historians of this period. It has been supposed that the English ministers were timorous about the power of Massachusetts and the New England confederacy, and held out this liberal treatment to the smaller colonies in order to ruin their support, disrupt the confederacy, and render Massachusetts amenable to

royal control. Documentary evidence is cited to show, not only that there is no foundation for this theory, but also to support the view that the charters were granted carelessly, chiefly because of the personal influence which John Winthrop, as agent for Connecticut, was able to bring to bear at court.

The central feature of Clarendon's colonial administration was the dispatch to New England of a body of commissioners to investigate and correct the disregard of royal authority supposed to exist in that community. But in this affair also, mismanagement was responsible for a complete failure. The commissioners accompanied the fleet sent out to seize New Netherland from the Dutch. This latter project undoubtedly held a much more prominent place in the desires of the English minister than the reduction of Massachusetts and to its attainment the investigations of the commission in New England were constantly sacrificed. The commissioners were carelessly selected and not properly instructed. Nor, after the conquest of New Netherland, were they adequately supported by the home authorities. What valuable recommendations they made were entirely ignored. And when they were recalled no steps were taken to enforce the orders they had given in New England, so that in a short time royal authority there was brought into greater contempt than before.

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PROCEEDINGS OF SOCIETIES

Scientific Association.

February 16, 1905.

On the Combination of the Solvent with the Dissolved Substance.   By H. C. JONES.

The Steam Turbine.   By J. B. WHITEHEAD, Jr.

March 16.

Notice of a History of European Thought.   By D. C. GILMAN.

Philological Association.

February 17, 1905.—Two hundred and twentieth regular meeting.   Professor Gildersleeve in the chair.   Forty-four members were present.

Monodrama in Goethe's Faust.   By H. WOOD.

Eugen Herzog's Theory of the Cause of Phonetic Changes.   By E. C. ARMSTRONG.

March 17.—Two hundred and twenty-first regular meeting.   Professor Gildersleeve in the chair.   Twenty-five members were present.

Studies in Higher Criticism.   By T. C. FOOTE.

On Conflicting Prayers and Sacrifices.   By M. BLOOMFIELD.

April 14.   Two hundred and twenty-second regular meeting.   Professor Gildersleeve in the chair.   Thirty-two members were present.

Poe's 'House of Usher.'   By H. WOOD.

Forms of the Numeral Five in Hebrew.   By F. R. BLAKE.

Historical and Political Science Association.

February 3, 1905.

The Apprentice System in the Building Trades.   By J. M. MOTLEY.

Dixon's The Clansman.   By B. F. WILSON.

Murphy's The Present South.   By F. B. ROSEBRO.

Crandall's Treaties : Their Making and Enforcement.   By R. T. CRANE.

February 17.

Tory Disturbances in Maryland, 1776–1781.   By B. W. BOND, Jr.

Cleveland's Presidential Problems.   By S. L. WARE.

Pratt's Organization of Agriculture.   By W. H. BUCKLER.

Rhodes' History of the United States, 5th vol.   By L. G. CORKRAN.

March 3.

The Finances of the Iron Moulders Union.   By A. M. SAKOLSKI.

Macy's Party Organization and Machinery.   By H. E. FLACK.

Lord Avebury's Free Trade.   By G. A. BAGGE.

March 17.

Secession in North Carolina.   By H. M. WAGSTAFF.

McKinley's Suffrage Franchise in the Thirteen English Colonies in
America.   By B. W. BOND, Jr.

Report of the Librarian of Congress for the year 1904.   By J. R.
TUCKER.

Carver's Distribution of Wealth.   By J. M. MOTLEY.

March 31.

Structure of the Cigar Makers' Union.   By T. W. GLOCKER.

Dunbar's Economic Essays.   By S. BLUM.

James and Sanford's Government in State and Nation.   By R. G.
CAMPBELL.

Vinogradoff's Growth of the Manor.   By J. C. HILDT.

April 14.

Freedom of the Press in France, 1815–1848.   By B. W. BOND, Jr.

Goodnow's City Government in the United States.   By D. S. FREEMAN.

Adam Smith's Wealth of Nations.   By F. W. HILBERT.

Ashley's Modern Tariff Systems.   By T. W. GLOCKER.

April 28.

An Historical Puzzle respecting the Birth of Talleyrand.   By D. C.
GILMAN.

Trevelyan's England under the Stuarts.   By C. F. RANFT.

Devine's Principles of Relief.   By J. B. KENNEDY.

Robertson's Selected Statutes, Cases, etc.   By J. C. HILDT.

Naturalists' Field Club.

March 7, 1905.

Some Adaptations in Certain Green Algæ.   By I. F. LEWIS.

Ortmann on Distribution of Crayfish.   By E. A. ANDREWS.

Shape and Use of Sperm Receptacles in Crayfish.   By E. A. ANDREWS.

April 4.

Plant Life in Maryland.   By FORREST SHREVE.

The Pecten in the Eye of the Bird.   By H. A. HACKETT.

May 4.

Polarity in Willow Twigs.   By E. A. ANDREWS.

Duration in the Blooming of Flowers.   By H. S. CONARD.

Batrachospermum and Chantransia.   By W. D. HOYT.

CURRENT NOTES

RECENT APPOINTMENTS IN THIS UNIVERSITY

Lewellys F. Barker, M. B., was appointed Professor of Medicine, April 3. Dr. Barker was graduated in medicine at the University of Toronto in 1890, and the following year he was a house officer in the Toronto General Hospital. He then came to Baltimore and was for several years an assistant physician and assistant resident pathologist in the Johns Hopkins Hospital. He was Fellow in Pathology in the University for two years, Associate and Associate Professor of Anatomy from 1894–99 and of Pathology during the year 1899–1900. For five years past he has been Professor and Head of the department of Anatomy in the University of Chicago and the Rush Medical College. He has published "The Nervous System and its Constituent Neurones," a translation of Werner Spalteholtz's "Hand Atlas of Human Anatomy," and numerous monographs and addresses.

William S. Thayer, M. D., was appointed Professor of Clinical Medicine, April 3. He is a Bachelor of Arts of Harvard University in 1885 and a Doctor of Medicine in 1889. From 1891 to 1898 he was Resident Physician in the Johns Hopkins Hospital. During the year 1895–96 he was Associate in Medicine in the University, and since then he has been Associate Professor of Medicine, Associate in Medicine in the Hospital, and Head of the Medical Clinic of the Dispensary. He is a member of the Association of American Physicians, of the American Association of Pathologists and Bacteriologists, of the Washington Academy of Sciences, and an honorary member of the Therapeutical Society of Moscow. He is the author of "Lectures on the Malarial Fevers," "The Malarial Fevers of Baltimore," and various articles in the medical journals.

David M. Robinson, Ph. D., was appointed Associate in Classical Archæology, May 1. Dr. Robinson is a Bachelor of Arts and a Doctor of Philosophy of the University of Chicago, where he held a fellowship for three years. He spent two years in the American School of Classical Studies in Athens, and one year in the Universities of Halle and Berlin, and during the past year he has been Assistant Professor of Greek in Illinois College. He is a contributor to the American Journal of Philology and the American Journal of Archæology.

GIFT OF A BUST OF SCHILLER

The King of Württemberg has presented to the university a bronze bust of the poet Schiller, a replica of a colossal bust, by Dannecker, in Stuttgart.

On April 29, at noon, an assembly of the Trustees, Faculty, Students, and invited guests was held in McCoy Hall, when the bust was formally presented, on behalf of the King of Württemberg, by Major-General Albert von Pfister, of Stuttgart.   President Remsen responded, accepting the gift. The degree of Doctor of Laws, *honoris causa*, was then conferred upon General von Pfister, Professor Henry Wood presenting him.

University Lectures and Addresses

Professor W. P. Mustard, of Haverford College, lectured on ''Tasso's Debt to Vergil,'' in the Donovan Room, March 17.

Professor Kirby Flower Smith gave a lecture on '' The Poet Martial,'' in McCoy Hall, April 5.

Professor Friedrich Keutgen, of the University of Jena, delivered two lectures on ''The Origin of Craftgilds in Germany,'' in the Donovan Room, April 10, 11.

John Edwin Sandys, Litt. D., Fellow and Lecturer in St. John's College and Public Orator of the University of Cambridge, gave a lecture in McCoy Hall, April 12, on the '' Italian Academies in the Revival of Learning.''

American Ethnology

Dr. John R. Swanton, of the Bureau of American Ethnology, Washington, began in March a course of weekly lectures on American Ethnology, with special reference to the social organization and the mythology of American races.   He has also organized a weekly class in the Dakota language, with interpretation of selected texts.

Other Lectures, Meetings, and Conventions in the University Buildings

Meetings have been held in the Donovan Room as follows : a lecture for the benefit of the Lawrence House Social Settlement, February 10 ; meeting of the Woman's Auxiliary of the Civil Service Reform Association of Maryland, March 1 ; meeting of the Consumers' League, March 31 ; a lecture before the Playgrounds Association of Baltimore, April 6 ; organization of a Maryland Branch of the American National Red Cross, April 24.

The annual public debate between students representing the third and second year undergraduate classes of this university was held in McCoy Hall, March 9.

A public debate between undergraduates representing Brown University and the Johns Hopkins University was held in McCoy Hall, April 8.

A public meeting of the Maryland Society for the Prevention of Tuberculosis was held in McCoy Hall, March 7.

Lectures under the auspices of the Baltimore Society of the Archæological Institute of America have been given, in McCoy Hall, by Professor J. C. Egbert, of Columbia University, on "Augustus' Altar of Peace and the Excavations of 1904 in the Roman Forum," March 16 ; by Mr. J. T. Dennis, of Baltimore, on "A Winter's Excavations in Egypt," March 22 ; by Professor D. M. Robinson, of Illinois College, on "Ancient Sinope in the Light of a Recent Visit," March 29.

Under the auspices of the Alliance Française, three lectures were given in the Donovan Room, March 18, 25, April 15, by M. René Millet, of Paris, on "La France et l'Islam dans la Méditerranée."

The Medical and Chirurgical Faculty of Maryland held three sessions of its annual meeting, in McCoy Hall, April 25, 26, 27.

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