lenticular; in the female, however, this eminence is divided into three minute points, which together are of the same size as the single elevation of the male; this seems to show that the male ocellus is formed of three elements united.

In all the heterocerous Lepidoptera which possess ocelli, these are two in number, and are placed one behind each antenna, probably therefore on the vertex. This difference is not extraordinary, for among the Hemiptera some groups possess ocelli below, some above the eyes, a difference still greater; while in other groups they are wholly wanting. In the genus Larema, to which *Papilio Accius* Sm.-Abb. belongs, two other species have been examined, *L. Pattenii* and *L. Hianna*. In the male of the former (the only sex examined) the ocellus resembles perfectly that of *L. Accius*; but there is not the slightest trace of ocelli either in the male or female of the latter; nor do they exist in the neighboring genera, so far as these have been examined.

December 3, 1873.

The President in the chair. Fifty-five persons present.

The following papers were read: —

Evolution of the Arietidæ. By A. Hyatt.

My researches continued during the past fourteen years upon the Ammonites of the Jura, but more especially upon the family of Arietidæ, have led to the following results.

The parent form of the family, which includes the genus or group Arietes, of Von Buch, and the series to which *Scipionianus* belongs,[1]

[1] This, however, does not include the group of *Amm. angulatus, Charmassei, Leigneletii* and *Boucaultianus*. These, by their young and adult forms, are distinctly separable from any of the true Arietian forms. The young have a stout, smooth whorl, followed by a stage in which the ribs are developed, and pass continuously over the abdomen. In the next stage the sides become flatter, the ribs on the abdomen divided by a channel, and in all the forms except *angulatus* or *catenatus*, the involution is notably increased. In the first old age stage the ribs again become confluent on the abdomen, and in the last stages almost or entirely obsolete. This stage compares in form and all its characteristics, with *Boucaultianus*, the last representative of this special series.

Catenatus and *angulatus* occur at Lemur with *tortilis* immediately above *planorbis*, and below the Angulatusbed. *Angulatus* with *Charmassei* and *Leigneletii* in the Angulatusbed, *Charmassei* continuing on into the Bucklandibed, succeeded by *Boucaultianus* in the Tuberculatusbed of Oppel.

is the species known as *planorbis* in England, and *psilonotus* in Germany.

In tracing the different series of species, it has been found that the forms differ in their adult characteristics, sometimes very decidedly, and in other instances hardly any definite line can be drawn between those of the same series. Thus Arnioceras, comprehending forms as distinct as the *miserabilis* of Quenstedt, and the *Ceras* of Giebel, may be described as one species; again *torus*, *tortilis*, *Liassicus* and *Nodotianus* are all distinct forms, and yet undoubtedly derivatives of the common stock, *torus*. It would be entirely ridiculous to describe the latter series as one species, but the former can be for the most part included under the name of *Amm. falcaries* Quenstedt. The difference is explained by the study of development.

Leaving out the first, or egg stage, common to all Ammonoid forms, and the Goniatitic, or second stage, common to all the Ammonites proper, the subsequent, or smooth stage, in *Arnioceras miserabilis* and its derivatives, occupies a notable proportion of the umbilical whorl, and has a peculiar form resembling that of the adult *planorbis*. The adult characteristics are slowly and methodically added after this stage of growth. Some individuals barely attain the form common to the genus; others, however, reach beyond this, and add by growth channels, and otherwise modify the form. In all cases, however, no sudden changes are made by the growth; each adult passes through a normal course of development, and the different characteristics distinguishing this or that variety or species, is gradually acquired, no abrupt changes being remarked.

In Caloceras, however, while all the young forms resemble *torus*, there is great latitude in the assumption of the adult form and characteristics, and differences, even in forms which must be regarded as varieties of the same species, are introduced suddenly during the later stages of growth.

The study of the adult individuals in Arnioceras would enable an observer to unite them, perhaps even into one species, as Quenstedt and others have done, and the study of the young would lead to a parallel result; but in Caloceras, while the consideration of the adults alone would lead to the distinction of numerous species, the investigation of the development alone would indicate here, as in Arnioceras, only one species.

Throughout the Ammonoids, we find everywhere instances of these two methods, the slow accumulation of differences, according to the

Darwinian theory, and their quick or sudden production, according to the law of acceleration, as explained by Cope and the writer, and subsequently by Mivart. The gaps between forms or species, may be largely explained by the latter mode of development, if the necessary care is taken to study the earlier stages, which should show the close genetic connection of the distinct adult forms, and explain thereby the absence of the intermediate varieties. By carefully observing these principles, it is possible to trace the entire family of the Arietidæ to one variety of one species, the smooth variety of *Psiloceras planorbis.*

The species are evolved from this single form in series of various kinds, some forming lines passing up through the various subsequent formations from the planorbisbed, giving origin in their turn to other series, and some remaining single.

Thus the whole picture is comparable to a genealogical tree, the trunk represented by the smooth *psilonotus*, which originates in the Triassic formation, and giving rise on either side to a fan-shaped array of branches, each branch representing a series of forms or species, and quite often having smaller branches of its own. In each case the point of origin of the branches or series is near the point of origin of the branch from which they spring, whence the fan-shaped arrangement alluded to above. Farther, each series perfects or carries a certain series of characteristics common to itself, and a certain series common to the whole family.

The first distinguish it as a genus or group, and the latter are the parallel or mimetic characteristics which are regularly produced in each individual, and each series, according to the place of the individual in the series.

Thus *psilonotus* is smooth throughout life, Arnioceras is smooth for a certain period in the young, then adds ribs, and a keel, then channels. The adult *Conybeari* adds tubercles on the ribs, which appear in a young stage of Coroniceras, a later appearing series, and then in the last number of its own series becomes more involute; this greater degree of involution appearing as a young characteristic in the last series of the family Asteroceras.

The old age changes observable in *psilonotus* are very slight, they become greater and more distinct in Caloceras, and succeeding series; finally in the last members of the series of Coroniceras they seriously affect the entire form of the adult, and in Asteroceras the adult of

Collenotii has precisely the same form as the old *Coroniceras trigonatum* or *Asteroceras obtusum*, and is also smooth.

Thus we have the common characteristics of the family produced independently, and in distinct series one after another in regular order in the species of each series, first in the latest member of the Conybeari series, then in the Arnioceras branch, again reproduced in Coroniceras, a descendant branch. Then reduced to a young characteristic, and finally abandoned, together with the channel and the form of the whorl and ribs which were also first elaborated in the adults of the Conybeari series, and Arnioceras, and replaced by characteristics which have first made their appearance in the old age of these very species themselves.

Thus the whole group may be compared to an individual taken out of either the highest and latest occurring member of the lower branch, Conybeari, or out of the centre of the Arnioceras branch, in Coroniceras. These have in each individual a smooth stage, or *planorbis* stage, then the adult with keeled, channeled, ribbed, tuberculated stage, followed by an old age in which all of these disappear, and the whorl becomes smooth, the sides convergent, the abdomen narrow and acute.

The young, therefore, compares with the adult of *psilonotus*, the adult possesses the characteristics elaborated by successive additions in the growth of the species which intervene between the individual and the point of origin of the series to which it belongs, and the old age points out the changes which must subsequently take place in its own series when the climax of development is reached, and the series is declining.

In other words, a series of species has, like an individual, a certain store of vital power which enable it for certain periods, more or less prolonged, to evolve new forms and new characteristics, but which in the end fails, and in place of farther progress in that direction we find an evolution of degraded forms, which compare exactly with the retrograde metamorphoses of the individual.

Size, which indicates vegetative growth, and the power to take in and assimilate large quantities of nutritive matter, which is usually called vital power, corroborates the above.

The size of the individual increases from *psilonotus*, which rarely exceeds four or five inches, to *Conybeari*, which attains the enormous diameter of over three feet.

Again, in the Arnioceras branch, the first appearing forms are very

small, only an inch or two in diameter, and steadily increase to *Coroniceras trigonatum*, sometimes two feet in diameter, and then decrease in Asteroceras gradually to *Collenotii*, which again hardly exceeds two inches.

The individual grows by constant addition of characteristics, or parts, and declines by the loss in those characteristics or parts, first of the power to perform their functions, and then by their obsolescence. Series of species, on the other hand, progress by the evolution of forms which, in their adult condition, add certain common or parallel characteristics in regular order, and then decline by the evolution of a series of forms exhibiting the obsolescence of the same parts or organs, each form inheriting at an earlier age the old age characteristics of the parent until finally none of the adult characteristics remain even in the young.

Observations on the Food and the Reproductive Organs of Ostrea Virginiana, with some Account of Bucephalus Cuculus Nov. Spec. By John McCrady.

During the year between September, 1868, and September, 1869, I had frequent occasion to examine points connected with the natural history of *Ostrea virginiana* in Charleston, S. C. The specimens examined were almost all what are known there as Millpond Oysters, and are grown under circumstances very similar to those depended on to produce the "green oyster" of the European markets. One especial feature of this mode of culture is that the animal is fattened upon a mud bottom, where it remains imbedded so as usually to be invisible in the thick layer of low organic forms, carpeting the whole surface of the mud in unbroken continuity, wherever this mud is found. This organic layer therefore covers many square miles along the coast of South Carolina alone, and furnishes the exhaustless supply of food upon which the oysters fatten. The layer itself, whenever I have examined it, seems to consist chiefly of a yellowish organic film, which upon microscopic examination, presents the appearance of a sort of endless convoluted frill attached everywhere along one border, and free along the other: the convolutions in their natural healthy condition presenting somewhat the aspect of the upper surface of *cumulo-stratus*. In this frill, which indeed seems to constitute the whole organism, which I shall provisionally call *Chthamoctistes cumulus*, I could never make out any structure. It