the Ute Indians, who occupy the western half of Colorado. After referring briefly to the traditions current among them respecting the origin of their tribe, he spoke of their recent rapid decrease in numbers through the ravages of the small pox. They still, however, maintain a tribal existence and a certain degree of organization. He then described their ways of living and domestic customs, referring to their burial rites and marriage contracts, and gave such information as he had been able to obtain respecting their religious ideas.

The following papers were read: —

Abstract of a Memoir on the "Biological Relations of the Jurassic Ammonites." By Prof. A. Hyatt.

The speaker traced the history of the evolution of the order of Ammonoids, showing that the characteristics of the first three stages of the embryo were inherited from a very early period. These were first, the sac-like shell of the embryo containing the equally sac-like beginning of the siphon,— prosiphon as it has since been called by M. Munier-Chalmas; second, the beginning of the true shell or apex, with its nautilus-like septum, and peculiar nautilus-like umbilicus; third, the depressed and goniatite-like continuation of the form of the shell with its accompanying goniatitic septa.

These of course represent only their most advanced stage in the Ammonites proper of the Jura and Trias; they are, when first observed in the Silurian and Devonian, exceedingly variable in the length of the periods and other important characteristics even between the varieties of different species. They become invariable in the young as embryonic characteristics only after the lapse of time represented by the Silurian, Devonian, and Carboniferous periods. This variability in the same species in the Silurian shows how recently they were inherited, and their invariability in every individual of the Jurassic shows the result of the long ages of inheritance through which the group has passed between that period and the Silurian epoch.

He then showed that in each subordinate group there were certain invariably occurring forms precisely similar to those found in other groups often widely removed in time and very distinct in the

structure of the parts. These are apt to occur with a certain fixity of succession which enables the observer to predict with considerable certainty the general characteristics of the succeeding forms of any given group after he has thoroughly studied the development and succession of a few of the lowest. They correspond to what naturalists are in the habit of calling parallel forms, often also representative forms. These forms begin in every group with which I am acquainted with a certain low or open-whorled form and evolve, in course of time and by inheritance, more and more involved whorls, or else the whorls are modified in the characteristics which usually accompany the normal increase of the involution, namely, by the increasing thinness of the shell laterally, flattening of the sides which become more and more convergent outwardly, and the tendency of the abdomen to become narrower. This and the origin of most of the groups from certain single ancestral species of the discoidal or open-whorled forms show conclusively that these forms arise independently in each group.

But it must be noticed that they can be only thus limited in each group or series of groups which are genetically connected. The range of forms comprehend every imaginable modification of the original inherited or stock form of the third stage among Ammonites. This is tubular or coniform and has an inherited tendency to grow by increasing the abdominal more than the dorsal side, thus revolving upon itself. Therefore while the choice or selection of the original forms by which a series starts into being is practically unlimited except by the possibilities of the typical discoidal form of the embryo and young, the subsequent development in each series becomes more and more limited according to the size of the group. The same law of inheritance which renders the embryonic form of the third stage fixed or invariable in each individual of the true Ammonites of the Jura, subsequently accomplishes the same purpose, to a less degree and with greater fluctuation, for the later developed forms and characteristics of each separate series or group, obliging them to evolve, if they progress at all, a certain succession of forms which have been described above.

It will be noticed that I use the word progress in a special sense as applicable to a certain class of parallel forms and not to those with which we shall presently deal, the old-age forms, which though equally perfect in the phenomena of parallelism, cannot be attributable to growth. The former are the mechanical results of the growth or increase in size of the shell of the common embryonic form

of the third and succeeding stages of the young, while the latter result from the natural but inevitable loss of growth-force in the adult shell and its parts.

This growth seems to me to be due to the favorable nature of the physical surroundings, primarily producing characteristic changes which become perpetuated and increased by inheritance within the group. We can recognize this in the constantly increasing size of the shell, complication and development of the new parts, as has been shown by Prof. Cope in his "Method of Creation of Organic Types." Though he does not attribute so much to the influence of the physical surroundings as has been done here, the results of my investigations are, as they have been heretofore, very similar to his.

The law or general expression for the mode of inheritance by which this is accomplished is the same for all characteristics, whether of form or structure ; namely, that of acceleration. By this I mean the constant tendency of every individual to inherit the characteristics of its parents at earlier periods than those in which they have appeared in the parents themselves. I know of no exception to this law, whether the characteristics are due to a healthy adult condition or to old age ; whether they precede or succeed the supposed period of reproduction. This I have already treated of fully in previous publications, and need only refer to the old age parallel forms, presently to be treated of, in order to make it clear to every zoologist that senile characteristics must be inherited or these series of senile parallel forms could have no existence.

This constant tendency to reproduce the ancestral characteristics at earlier and earlier stages accounts for the reduction of the principal characteristics of the Nautiloids and Goniatites to an embryonic condition in the young of the Jurassic Ammonites.

It also accounts for the inheritance of the more and more involved form in each of the subordinate series. This becomes apparent when the parallel forms of any series are traced from the primary discoidal or open umbilicated through the intermediate forms to the most completely involved.

We find in all cases the more discoidal or primary with all its characteristics, whatever they may be, repeated at earlier stages in each species, until at last in some of the most involved, all perceptible traces of its existence are lost. Then and only then can the series be said to die a natural death. When this form appears I have never found another. The reason for this is that in all cases the disappear-

ance of the primary or ancestral form and characteristics of the series is due to the encroachments of the inherited old age characteristics. When these, which are essentially degradational, begin to be inherited in a race, the adult characteristics begin to be confined to younger periods of growth and finally disappear altogether, the shell showing certain old age or inherited senile characteristics from the beginning of the fourth stage. Everywhere this mode of inheritance by acceleration occurs, everywhere it seems to govern the succession of the forms. I have not, however, been able yet to trace the precise connection between all the roots of the secondary series. If this could be completely done, which I fear is impossible at present, no doubt some similar relations would be found.

Besides those parallel forms which may be called progressive, there are others in the same groups which may be shown to be due to the inheritance of the old age of these same parallel forms, and, by comparison with similar forms prematurely produced in the different species by disease or local influences, they may be attributed to similar causes, namely, the action of unfavorable surroundings. It is no exaggeration to say that in many instances the small, dwarfed forms produced by disease are very similar to the normal and large old age forms of the same series. This resemblance extends sometimes even to the mode of development. Disease thus produces directly an effect similar to the normal action of the laws of inheritance through a greater or less period of time under the influence of physical surroundings.

The word surroundings is now used instead of environment, for the reason that environment covers the whole ground of physical causes which may have either a remote or immediate effect upon the life of the species.

The environment, or the sum of the physical influences, however favorable it may seem to be, is, as is well known to all physiologists, perpetually inimical to the prolonged existence of life, and brings about in the individual the retrograde metamorphoses known as old age, and leads to death by the disuse, atrophy and decay of the functions and organs.

These changes in the individual are in precise correspondence with those taking place in a group, and, as has been shown, these characteristics are acted upon in their transmission from individual to individual, during the decline of the group, by the same law of inheritance as are the progressive characteristics during its rise. Thus it

becomes possible to compare the life of the individual with the life of the group to which it belongs, the period of growth and development to the period of the progressive evolution of new forms, and the period of old age with its retrograde metamorphoses to the period of decline during which retrogressive forms are evolved. This comparison and the facts noted above enable us to attribute the parallel modifications of forms, whether occurring during the progressive or declining period in the existence of a group, to the direct influence of the environment.

Besides these characteristic forms and structural parts which are parallel, there are many others in each group not classified under the head of similarities but under that of differences, in so far as they distinguish the groups from each other. These may be often followed back to varieties of one species, showing that certain varieties have given rise to the groups. These varieties are few as compared with the whole number of varieties traceable in these original ancestral species.

Thus it seems clear, that these varieties must have had certain advantageous peculiarities enabling them to survive the climatic or geological changes, which destroyed the weaker descendants of the same stock, and that these peculiarities rendered them capable of perpetuating their race until they arose into a group or series of genetically connected forms.

Unless the Darwinian law of natural selection, or the survival of the fittest, does apply to the perpetuation of these structural differences which distinguish groups from each other I am entirely at loss in my attempts to account for them. I here carefully guard against attributing the origin of these differences to the law of natural selection, but limit its action strictly to the modification of the structural differences which tend to appear first in the varieties and then by inheritance in larger and larger groups and at earlier and earlier stages in the life of the individual.

It may also be shown by Cope's law of the origination of differences by growth that the origin of these differences probably lies in some law of growth under the influence of the physical surroundings, supply and kind of food, climate, etc. Thus they may be said to be due to growth modified and directed by the Darwinian law of natural selection, both of these being directly subject to the influence of the environment, or the sum of all the physical influences brought to bear upon the organization.

This conclusion, it will be noticed, is strictly in accordance with the general tendency of zoological opinions at the present time and almost identical with the results taught by Herbert Spencer in his works on biology, although I was not aware of this until after they were written. Many of the facts supporting the positions assumed have already been published in various scattered papers, but these will be united and accompanied by others since discovered in the partially completed memoir of which this is an abstract.

Preliminary Report on the Cretaceous Lamellibranchs collected in the vicinity of Pernambuco, Brazil, on the Morgan Expedition of 1870, Ch. Fred. Hartt in charge. By Richard Rathbun, Assistant in the Museum of the Boston Soc. of Nat. History.

After partially completing his explorations on the lower Amazonas during the Morgan Expedition of 1870,[1] Prof. Hartt directed two members of his party, Messrs. O. A. Derby and D. B. Wilmot, to explore various portions of the coast, between the mouth of the Amazonas and the city of Pernambuco. In the neighborhood of the latter place were found several outcrops of fossiliferous rocks, which have since proved to be of cretaceous age. Quite extensive collections of the contained fossils were made and sent to this country, and last year the mollusca were offered me for study.

The localities from which the specimens were obtained are three exposures, situated at and near the mouth of the Rio Maria Farinha, and all included within a radius of two or three miles. The Rio Maria Farinha is but a small stream, which, in the latter part of its course, flows nearly due east, and enters the ocean at a point about eighteen miles north of Pernambuco, and a few miles south of the island of Itamaracá, lying just off the coast. On the north side of the river, at its mouth, is an elevated point called Nova Cruz, which rises in a cliff about twenty-five feet in height and is composed mostly of beds of colored clays. In the upper part of this cliff appears a single layer, about three feet in thickness, of a grayish, fossiliferous limestone, with clay immediately above and below it. The entire cliff is

[1] For a brief account of this Expedition, see "Preliminary Report of the Morgan Expeditions, 1870-71," by Ch. Fred. Hartt. Bulletin of the Cornell University, (Science), Vol. I, No. 1, 1874.