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THE FICTION OF THE AMERICAN HORSE AND THE TRUTH ON THIS DISPUTED POINT.

BY DR. E. L. TROUESSART.

THE article of Mr. Robert C. Auld, published in *Science*, Sept. 2, 1892, brings before us the question of the introduction of the horse (*Equus domesticus*) into America, It is generally accepted that Europeans brought it to the New Continent, and that it was in La Plata that Mendoza, in 1530, introduced horses. Before that time, the natives were familiar with the llama only.

The only document which contradicts this historical fact, is a map published by Sebastian Cabot, on his return to Europe, that is after 1530, and which, moreover, had several editions. On this map, Cabot figured the horse as a production of the Rio de la Plata. It is difficult to attach any faith to this assertion of Cabot, since it depends very probably, upon the same doubtful grounds as the existence of the gold and silver mines in this country to which he gave, fortunately or unfortunately, the name of "La Plata." We know that all the objects of gold and silver which Cabot obtained from the natives were brought from Peru and from Chili, and that no metallic productions of any kind are to be found in this part of the Argentine Republic. But to Cabot—desirous above all things of dazzling the King of Spain, and later the King of England, in order to obtain the command of new expeditions for discovery—it was essential to make it appear that these lands abounded in riches and supported large herds of horses. It is quite likely, too, that Cabot knew that the horse, recently imported into the country, could survive there and multiply in a state of freedom.

Be that as it may, all navigators who visited Rio de la Plata, before and after Cabot, contradict his assertions and agree in affirming that the natives did not know the horse. Pigafetta, notably, the historian of the voyage of Magellan, who visited Rio de la Plata in 1519, and who enumerates with care all the productions of the animal and vegetable kingdoms of that country, says authoritatively that the natives knew no other beast of burden than the llama (*guanaco*).

It is time, therefore, to make an end of this fiction of the native American horse. It is certain that this animal was imported by Europeans into America and that the *Equidæ*, which had formerly existed on that continent, were entirely unknown to the red men. We recall the terror of the Caribbeans, the Mexicans, and the Peruvians, at the sight of the Spanish cavaliers: they believed themselves in the presence of a herd of centaurs. Geological and palæontological evidence in regard to the Argentine Republic abounds, also, to prove, in the most convincing manner, that there elapsed a period, between the extinction of the indigenous American horse and the appearance of the domestic horse imported from Europe, which was quite long enough to be appreciable geologically. This is the point which is now to be demonstrated.

We know that the horse of three toes (*Hipparion* or *Hippotherium*) existed in the north of the two continents at the end of the tertiary period (Pliocene and Quaternary). The genus *Protohippus*, considered the direct progenitor of *Equus*, differs very little from *Hipparion*, and may be regarded as a simple sub-genus of the latter. This genus, *Protohippus*, which numbers several species, lived in North America during the Pliocene epoch. The true genus, *Equus*, appeared soon after in the same country (from the Pliocene epoch), and several species (*Equus crenidens, E. barcæni*, etc.) are contemporaneous with *Hipparion* and *Protohippus*.

A genus akin to *Equus*, the genus *Hippidium*, is found also in the Pliocene age of North America (*Hippidium spectans*, Cope). This genus is the only one (with the true *Equus*) which is found in the Quaternary epoch in South America. Indeed, *Hipparion* and *Protohippus* are not known there, and *Hipphaplus* (*Ameghino*) is too little known to take up our attention here. There seems to be no doubt, therefore, that the South American horses of the Quaternary age spread gradually across the continent, from Mexico to Colombia, Brazil, and the Argentine Republic, for before this period *Macrauchenidæ*, the *Proterotheridæ* and the *Tapiridæ* were the only Perissodactyls living in the last-named country.

The South American horses (genus *Hippidium*) bear characteristics which forbid confusing them with the Hipparions and the horses of the North. Those of South America had thick, squat bodies, large heads, slender legs tapering to small hoofs; their molar teeth were of a shape more square than those of the true horse. These peculiarities are found again, in a measure at least, in horses of the same country which have been referred to the true genus *Equus*. In the same way, the *Equus lundii* of Boas, which lived in Colombia in the Quaternary period, has been compared to the zebra because of the thickness of its form. The other species which were found in the Argentine Republic are *Equus curvidens, E. argentinus*, and *E. rectidens;* this last is the one which lived longest in this country where it must have been hunted and eaten by prehistoric man. In the "étage platien" (upper Quaternary) are found bones of this horse (*E. rectidens*) associated with chipped-stone implements, with pottery, fire refuse, etc., which are the evidences of the presence of man. The long bones of this horse are often split for the extraction of the marrow and the skull broken for the brains. The shape of the teeth enables one to distinguish at once between the *Equus rectidens* and *Equus caballus* of Europe.

If we study now the geological strata of the Argentine Republic we may form the following table whose elements we borrow from Mons. Fl. Ameghino:

ETAGES.		EQUIDÆ QUI S'Y TROUVENT.
Aérien (actuel)		*Equus caballus domesticus.*
Aimara (récent)		(Pas trace d' *Equidæ*).
Platien (post-pampéen lacustre)		*Equus rectidens.*
Guerandien (post-pampéen marin)		(Pas de Mammifères terrestres).
Lujanien	Pampéen	*Equus rectidens.*
Bonairien	Pampéen	*Equus argentinus.*
Belgranien	Pampéen	*Equus curvidens.*
Ensenadien	Pampéen	*Hippidium* (5 sp.).
	Pampéen	*Hipphaplus* (2 sp.).

This table, in which the "ensenadien" formation is the most ancient, and the layer "aérien," or actual, the most modern, shows, in the most evident manner, that the true horse of South America (*Equus rectidens*) was extinct a long time when *Equus caballus*, coming from Europe, made his first appearance in the Argentine Republic.

Indeed, the "Aimara" formation, where the bones of the llama (*Auchenia guanaco*) are abundant, presents no trace whatever of the genus *Equus*.

This geological proof seems to me to be absolutely incontrovertible, and reduces to *nil* hypotheses built on the apocryphal documents left by an adventurer like Sebastian Cabot, the inaccuracies of which, not to say the fancies, are shown by the examples we have cited.

The true horse (*Equus*) has been scattered more widely, and has given rise to more species in North America than South America. It is interesting to recall here that the remains of *Equus caballus* have been discovered in the Quaternary beds (Pleistocene) of Canada and of Alaska. It is therefore certain that this species has existed in the *wild state* in the American Arctic region. But it is not less certain, according to all historical documents, that this animal had not existed for ages when it was introduced by Europeans in the early part of the 16th century. What is the cause which brought about the extinction of horses in North America as in South America before the commencement of the present period? This is not the place to discuss that question. But I cannot refrain from remarking that the extinction appears to have coincided with that of the *Proboscidians* (Elephant, Mastodon) and can consequently be attributed to the same causes which are to be sought in the environment of these *Herbivoræ* (nourishment, nature of the soil, etc.)

For the present it will suffice to establish that the *Mastodon superbus* was contemporaneous with the *Equus rectidens* in the in the Quaternary (Pleistocene) of the Argentine Republic. Also *Elephas primigenius* is found with *Equus caballus* in the same age in North America. All these types of animals became extinct in the New World, although horses and elephants have continued to live in Asia and in Africa up to the present time.

ADAPTATION OF SEEDS TO FACILITATE GERMINATION.

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THE observations recorded in these notes are based upon the general law of evolution, that organisms are constantly adapting themselves to secure advantages in their struggle for existence; and, because of this, it is to be expected that all modifications of organisms have some explanation in the economy of their existence.

From the initiation of the young plant into life at the time of fertilization of the ovule, to the end of the life of the mature plant, there is no more critical period in its existence than when it is dormant in the mature seed. It may be said in objection to this statement, that such seeds as corn, wheat, and garden seeds in general, when planted, almost all germinate, and this is true; but these seeds are removed by artificial intervention from the competition with which those planted naturally are compelled to struggle. These seeds, then, may be left out of consideration.

Careful observation of the seeds of native plants shows that a very large percentage of them never germinate. Some, no doubt, were never fertilized. I have counted a thousand seeds of different species of plants belonging to the Order Compositæ, and then planted them carefully, giving them as good, if not better, conditions for germination than they would have had if they had been planted naturally, with the result that in most of the species a comparatively small number germinated. Anyone who will take the trouble to search for seedlings of our native perennial plants, and compare the number they find with the number of seeds produced by the plant, will be convinced without further argument that the larger proportion of seeds produced by wild plants never germinate at all. In view of the critical period in the life of the plant when it is dormant in the seed as an embryo, and recognizing the evolutionary law of the survival of the fittest, is it not reasonable to expect that modifications of the seed will be developed which will facilitate germination? What are some of the modifications which increase the chances for germination of the seed?

In general, it may be said that seeds vary as to the structure of the parts within the coats, as well as to the external appendages of the outer coat. The internal characters are concerned with the embryo and the albumen. The embryo is the essential part of the seed. It consists of an initial stem, the hypocotyl, at each end of which is a growing point, one, the plumule, destined to produce the stem, the other, always at the other end of the hypocotyl (usually termed the lower end), from which the primary root starts. At the upper end of the hypocotyl, but below the plumule, are the cotyledons, sometimes large, sometimes small. Surrounding the embryo more or less, and inside the coats, is the material upon which the embryo is nourished until it can carry on an independent existence. This is termed the albumen of the seed. Around all are the seed-coats.

Moisture is as necessary to the germination of a seed as any other external condition. The necessity for moisture would make it highly probable that seeds should have special modifications to secure it to the seed. It is my purpose to point out some of the adaptations which seem to me to be designed to increase the facility and certainty of germination by securing and likewise keeping constant the supply of moisture for the seed. Some of the characters which will be mentioned have been considered as aiding the seed in its distribution. These are flattened or feathered appendages commonly known as pappus, coma, etc. It is not my purpose to belittle the office of distribution as performed by these organs, but it does seem to me true that, while these organs do assist the seed in dissemination, they, at the same time, aid in bringing it into the most advantageous position for germination. This advantage is often gained by the correlation of the internal parts of the seed, especially the growing points, to the external appendages of the seed or fruit. It is frequently the case that there is but one seed in the ovary, and the coats of the ovary closely invest the seed. Such a fruit is an akene. If the ovary- and seed-coats are completely fused together, the fruit is a caryopsis. For the purposes of our study these fruits may be included in the same category with seeds proper.

The correlation of parts in the seeds of many species is very striking. In the akenes of most of the species of the Order Compositæ it is especially noteworthy, and in several other orders seeds occur showing the same correlation. They might well be likened to an arrow. The feathered end is light, the head is heavy. In falling, the heavy part, i.e., the part which contains the embryo, is brought by the force of gravity invariably into close contact with the soil.

The same correlation of parts may been seen in the winged fruit of any species of maple. There is a very fruitful silver-leaved maple (A. dasycarpum) near my study. Under it passes a hard gravel path. The fruits that fell in the smooth path, of course, fell over on their side. Those that fell in the grass of the lawn, almost invariably assumed a position with the wing up and the body of the fruit down in the grass and leaves in contact with the moist soil. Further, I found that not a single seed in the path had germinated, when many of those in the grass had done so. It was interesting to see those large seeds all wing-up in the grass.

Most of the fruits of plants belonging to the Order Compositæ are especially adapted to facilitate germination. As is well known, the fruit is crowned with a pappus, which in a majority of cases not only acts like a parachute and bears the seed away, but at the same time lands it always a certain end up. The hypocotyl is very short in proportion to the length of the cotyledons, and is always in the lower end of the seed. Thus the growing points are brought into close and constant contact with the moisture of the soil. I have observed these akenes in fields and woods lodged usually, I might safely say, almost always, in such a position as to bring the akene with its lower tip in contact with the soil. If it fell in an open, smooth place, it would tip over, but, although reclining, would still have the lower tip upon the ground. If it fell among grass, leaves, or *débris* of any sort, as seeds are very apt to do, these would keep it in an upright position, and, on account of the barbed or upwardly roughened nature of many forms of pappus, it would work its way down until it came in contact with a suitable place for germination.

To determine whether this could be proven experimentally or not, I carefully selected a certain number of seeds of twenty different species, and planted one half of them one end up, the other half with the other end up. I had grave doubts about the success of the experiment, and should not have considered the proposition improbable had no differences in the rate of germination appeared.