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 But it is not less certain, according to all historical documents, that this animal had not existed for ages when it was introduced by Europeans in the early part of the 16th century.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.

BY W. W. ROWLEE, CORNELL UNIVERSITY, ITHACA, N.Y.

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.

All the seeds were placed under the soil and put as nearly as possible under the same conditions. Whenever the weather was dry, they were watered twice every day. Five species germinated twice as many seed when planted pappus end up as the same species did when planted pappus end down.

This at least suggests a reason for the inversion of the ovule in these and many other seeds. By assuming the anatropous form, the seeds in this order are able to bring their hypocotyl near the opening at the base of the akene, and at the same time secure advantages to themselves in the process of germination. I cannot help but believe that these adaptations are a factor in making the Order Compositæ the largest of the orders of flowering plants, in the number of its species as well as in the great abundance of individuals in some of its species.

WOMAN'S WORK FOR WAGES.

BY C. R. HENDERSON, RECORDER AND ASSISTANT PROFESSOR OF SOCIAL SCIENCE IN THE UNIVERSITY OF CHICAGO.

SOCIAL science has few more important problems than the conditions and effects of the earning of wages by women. Some sanguine advocates of women's rights apparently do not see that there are grave perils attending the enlargement of industrial activities on the part of the natural mistress of the home. They hail with rapture unmixed with foreboding the mere fact that the former "slaves of men" are becoming independent of the lords of creation. That access to new employments has its bright side there can be no reasonable doubt. There is a physical gain if the work is confined within certain limits and is adapted to the frame and forces of the sister toiler. Regular labor in sunny and well-ventilated rooms, or even in the open fields, is far better for health than idleness and husband-trapping. Intellectually, the sphere of mental life is vastly enlarged by the modern diversity of employment. There are domestic and social advantages in being able to wait and select a husband rather than take up the first thing in the shape of a man who offers a secure living. The economical advantage is so apparent that it needs nothing more than mention. At first sight all that a girl earns is clear gain, and is an absolute addition to the income of the family. In many occupations the dexterity, deftness, and honesty of female helpers have proved their superior value. As nurses, physicians of women and children, matrons of institutions requiring the presence of ladies, their gentleness and insight have been an untold blessing. These advantages are so real and great that any modifications of the present tendency to widen the industrial sphere of woman must take them into the account.

But there is also a very dark side to this subject. Passing the dangers of imposing labor prematurely on young girls, consider the indirect effects of feminine competition in some lines. That which we first see is a positive addition to family revenue. But later we discover that girls are taking the places of men at lower rates. This often means that the natural head and bread-winner is out of work or is receiving the woman's rate. The girl has herself to support, and that only in part. The man must support at least four persons. What must be the effect on domestic life? That which is actually observed: the husband and father at home while the daughter or wife is in the factory earning the living. Marriages are dimished, and among those most suitable for parents there are fewer births. A recent French economist of high repute gravely declares that the State ought to support and educate foundlings and orphans because the better members of society either cannot or will not keep up the population. What must be the results of propagating a human stock with such pedigrees? Ask the Kentucky horse-breeders. Think of the disorder of households where the normal conditions are reversed, the wife being in field or shop. Dr. Bushnell wrote about a "a reform against nature." It is against civilized human nature to throw the burdens of procuring sustenance upon those who have all they can endure in bearing, nursing, and starting the education of children. That cannot be a good tendency, economically or morally, which tends to extinguish a higher race. Herbert Spencer, in his pages on the *status* of women, gives abundant illustrations of the law that the imposition of bread-winning on women belongs with savage conditions.

What can be done to secure the advantages of women's work for wages and avoid the perils? There are natural forces which counteract the momentum of these evils. Fortunately it is the disposition of most women to have a home of their own. This inclination, deep as human life and old as history, removes much female competition. But unconscious forces need to be supplemented by foresight, prudence, and philosophy. Biology, as De Greef teaches, is not sociology. There is a physical law of "must" and a moral law of "may" and "ought." Women should be taught that she who works for less than normal wages in order to get "pin money" is the foe of her kind, and is undermining the foundations of economic and domestic welfare. This conviction, once generally diffused, will create trade-unions. These unions, because they are human, have done many foolish and wicked deeds. But they never did a more foolish or wicked deed than they have done who taught that unlimited work of women, at any price they could get, was an unmixed good. If women unite and demand the normal rate of wages then it will be found out whether it is really profitable to hire them. If their peculiar gifts give them superiority they will retain their places at the proper rate. If men are really more fit for the places, they will be preferred. Thus this social disease might be healed. To let it alone is to let a cancer alone, or permit incipient consumption or germs of cholera to have free-course. To take hold of the evil with will and unity is to cure it. Thus alone will young men be able to marry at a suitable age, and young women will generally find their most congenial and happy places as mothers and educators and home-makers. There is sufficient earning force in men without forcing children to eat scraps of bread and cake out of scavenger barrels and without compelling women to exhaust their energies in field and factory.

HEREDITY.

BY JULIA BROWN STRODE.

ALL men are created free and equal, says that famous document the Declaration of Independence, and, in a remote and abstract sense, it may be true; but, all in all, we are bound by a thousand chains, and equality is unknown. Fetters have been imposed upon us by our forefathers; limitations have been set us by our ancestors, which it will take years of study and self-culture to overcome. And as to equality, this man may average well in one particular with his fellow-men, but is totally deficient in another respect, and no two men are alike. Many of the lower tribes in Africa, says Stanley, resemble the ape more nearly than human beings. Either these lower classes have sprung from a brute ancestry, or their lives and environments have continued such that they have taken on the dispositions and appearance of the higher animals with which they have been surrounded, and have transmitted them to their progeny. Whether we accept the theory of evolution or not, the fact remains the same, i.e., that many savage tribes are more allied to animals than to civilized man. But, whatever our parentage is, or may have been, true worth is recognized and acknowledged wherever it may be found.

The problem of how to intensify the higher attributes of human nature and obliterate the unworthy is the problem of the age. The old theory that children were sent into the world, figuratively speaking, mere pieces of blank paper was long ago exploded. The paper is all written, traced, and re traced. The child has as decided a character, though not one so easily discernable, when it enters the world as when it leaves it. As genius, disease, peculiarities of appearance often transmit themselves from parent to children, so do villainy, crime, and moral depravity.

Here is a child with the idiosyncracies, the peculiar mannerisms, of his great-grandfather dead before he was born. I know of a boy whose attitudes and voice are like no other member of his family, but that of an uncle whom he never saw. Often an individual returning to his home town, from which he has for years been absent, readily determines to what families the new-born generation belongs.