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THE WONDERSOF THE EGG.

In the radiates, the lowest type of the animal kingdom, the eggs are mostly microscopic. I shall have more to say of them hereafter, and of other modes of reproduction common to this type. Before entering upon this part of my subject I wish to make a broad experimental statement about all eggs and all animals. These eggs, whether of vertebrate, articulate, mollusk, or radiate, appear at some time or other to be identical in structure, At least, no investigater has ever been able to detect any essential difference in them. They are all formed in an organ belonging to the maternal being, known as the ovary. In some animals this organ is very simple. Whatever its structure, however, whether complex or simple, there is a spot in the female organism known as the ovary, in which eggs are formed, from which new beings may be developed. But before the egg develops into the new being, it must be fecundated. For what I have said thus far with reference to absolute identity of egg structure througout the animal kingdom refers only to the egg as egg, before the process of fecundation takes place. There is an organ in the male organisms, corresponding to the ovary in the female organisms, in which sperm cells are formed, the contact of the contents of which with an ovarian egg is an indispensable condition for the growth of a new being. There are no animals known in which these corresponding organs do not exist.

Reproduction in the vegtable kingdom is based on similar structures with similar relations to one another. These two conditions, essential to the maintenance of types, should be well weighed by any one who would approach the problem of the origin of life.

Before showing you the structure of the egg proper, as it exists in all animals before it takes upon itself any individual character, I will say a word on other modes of reproduction, in order that you may have before you the whole subject, and that I may not be limited in my comparison to the ovarian eggs and fertilizing cells, but be able to include budding and self division among the reproductive processes.

With radiates, especially among the hydroids, multiplication by buds and by self division is common. An individual such as I sketch on the board (hydroid), puts out a bud from the main trunk. This bud grows into an individual similar to the parent, and it gives rise in its turn to a number of buds which go on multiplying in the same way till a large community is formed. In other instances such buds may drop off, and become free, individuals. Sometimes again, new individuals arising in this way differ from the parent, and only in their offspring reproduce a being resembling the one from which they sprang. Many hydroids, and even some of the acaleps, multiply by a still more simple process—that of self division. The primitive stock breaks up transversly at regular intervals by constriction, and each such part, when thrown off, becomes a new individual, while the parent remains unimpaired in its vitality.

Certain worms, also, multiply in this way, dividing into parts, and each part building itself up into a new and perfect being. Instances are also known of longitudinal division leading to the same result. Not only is it true that there are other modes of reproduction besides that of eggs, but it is also a fact that the antagonism between male and female, on which the whole processes of multiplication and increase among animals seems to rest, is not always necessary for the production of a new individual.

There are cases in which the germ is formed, and passes through all the changes until it reaches the adult condition without being fecundated at all. We owe this discovery to Liebold, who followed the whole history of the unfecundated egg in species of moths, with an ingenuity and perseverance which leave no possibility of doubt as to his results. There are also cases which exhibit an essential difference in the product of a fecundated egg and of one wihich has not been fecundated Upon such difference rests, for instance, the whole economy of the bee community. All the eggs laid by the queen bee prior to copulation produce males, and these males are what are called drones. The working bees are undeveloped females, and are the product of fecundated eggs. What is called the queen is the result of a special training of one of these imperfect females. the workers choose one of their number, and, by peculiar treatment and mode of feeling, etc, develope her into a perfect queen whose office it is to mutiply the community. There are also some butterflies which produce perfect male and female individuals from non-fecundated eggs.

The young shark is favored at his birth with what seems to be an egg. It is, however, a bag of nourishment, suplied by the maternal parent, which keeps him in food until he is a able to set up in business for himself.

What now, we would ask, is the significance of an egg? Is the egg itself an individual? Is it a new being? I think as we go on we shall be brought to the conclusion that the egg is the new being, endowed with an individuality, that is with a typical character so distinct that never since the world began did the egg of any one animal produce an animal differing from the parent in essential features, or the seed of any plant produce anything differing essentially from the plant which bore it.

Whatever phases an egg passes through, however much it transiently resembles the adult condition of some animal lower than itself in the same type, it never ends by broducing anything but the kind of animal from which it arose. There is not a solitary instance on record of a deviation from that ever reccuring cycle of development which shows a succession of specifically identicial individuals as the result of reproduction, whether through eggs, budding or division. There are no other modes of multiplication known.

An egg does not necessarily lead to The formation of one single being. the egg of the natica, for instance, often divides to form several individuals, though it may also develope as one being. In many instances, however, the natica egg, beginning as one yolk breaks up into two, four, or more, one primitive individuality thus dividing and transmuting its peculiarities to a generation more numerous than itself. This is not the case when double birth takes place in higher animals, in the mammalia for instance. Each individual is in that instance the growth of a separate egg. So in monstrosities in the quadrapeds, where double heads and the like, abnormal developments occur; they come from merging of the eggs together. The multiplying of indiviuals in one egg seems more like the process of reproduction by self division, as in hydroids and worms; only in the latter it is a kind of reconstruction of lost parts, while in the fomer it is the imperitive egg growing into several being. The more we examine these various process of multiplication among animals, the more are we impressed with the fact that the maintenance of kind, the fixedness of features in the organic world, is their primary object and inevitable result. At least that is the conclusion to which all my own studies in embryology have brought me.

The reproduction of individuals does not go no constantly. It is periodical and this periodicity varies in different animals. Some animals require a long development of themselves before they produce eggs. Others lay eggs very early in life. Fowls begin to lay the first year after their birth. Fresh water turtles do not bear young before their tenth or eleventh year, sometimes not till their twelth. In our common black and yellow dotted fresh water terrapin, and in the black terripin, the eggs require four years of growth before they or laid. Take a seven year old turtle of this kind; it will contain only very small eggs, all of uniform size. An eight year old turtle of the same kind will have two sets of eggs, one larger and one smaller One of nine years will have three sets, the oldest set being the size of a small pea. A turtle of ten years will have four sets of eggs, and in that year she will lay for the first time, and give birth to the most mature set.

Other animals require but a few weeks to bring their eggs to full maturity. In our common jelly fishes, for instance, with rose collored ovaries, the eggs begin in May. In July they are all laid and the young begin their independent life. The season of laying differs greatly in different animals. Some lay their eggs in spring, others in midsummer, others, as the trout amily, salmon and the like in autumn.

The irregularity of number is another astonishing feature of this problem of reproduction. It would seem that some kinds of animals require a far grater number of individuals for the maintenance of the type than others. Some animals multiply by hundreds of thousands—nay, by millions. Others bring forth a single new being, or at the most two or three at a time. Some animals bear but once and then die. Others, more tenacious of life, bring forth new broods for a long period of years These various conditions, of growth duration, and ripening these extriordinary difference in the power of multiplication and reproduction, are no doubt a necessary part of the economy of the whole animal kingdom There is nothing variable or capricious about it, and we must not forget that whoever would account for the origin or successive introduction of the different types of organized beings which have followed one another upon earth must include in his explination the whole scheme by which characteristics are continued and transmited.

Before closing, and as a preperation for my next lecture, I will show you what is the ovarian egg. (Drawing on the blackbord.) It is microscopic in many animals; but what-ever its size it consists of an outer bag filled with a semitarnsparent fluid, which is somewhat oily, and an inner bag also filled with a transparent fluid, which is cheifly albuminous. The difference in the character of the two fluids gives grater translucence to that which fills the inner sac.

Within the inner bag there is a spot o dot, sometimes severval of them, more or less distinct. In this condition all the eggs I have shown you, all eggs born of whatever living creature, are alike.

It appears from official statistics published in the Moscow *Gazette*, that only 9 per cent, of the population of Russia are able to read; and that excluding Poland and the Caucasus, and the cities of St. Petersburg and Moscow, there are only six hundred and twenty four agencies, for the dissemination of literature, including book shops, public libraries, and newsrooms amongst a population of 55,000,000,000.

INTELLECTUAL CULTURE

The consideration of the development and growth of the intellect furnishes the only true principles by which to regulate the culture of the intellect, and to arrange the order in which the different branches of knowledge should be studied.

The studies which should be first pursued are those which require and discipline the powers of observation and aquisition, and which involve imagination and memory, in contrast with those which demand severe efforts and trained habits of thought. Inasmuch, also, as material objects are apprehended and mastered in earley life with far greater ease and success than the acts and states of the spirit, objective and material studies should have almost the exclusive precedence. The capacity of exact and discriminating perception, and of clear and retentive memory, should be developed as largely as possible. The imagination, in all its forms, should be directed and elevated—we do not say stimulated, because, in the case of most children, its activity is never-tiring, whether they be at study, work, or play.

We do not say, cultivate perception, memory, and fancy, to the exclusion or repression of thought, for this is impossible. These powers, if exercised by human beings, must be interpenetrated by thought. If wisely cultivated by studies properly arranged, they will necessarily involve discrimination, comparison, and explanation. To teach pure observation, or the mastery of objects or words, without classification and interpretation, is to be ignorant even to simple stupidity. But, on the other hand to stimulate the thought-processes to unnatural and prematurely painful efforts, is to do violence to the laws which nature has written in the constitution of the intellect. Even thought and reflection teach us that, before the processes of thought can be applied, materials must be gathered in large abundence; and to provide for these, Nature has made acquisition and memory easy and spontaneous for childhood, and reasoning and science difficult and unnatural.

The study of language should be prosecuted in childhood, as it is, is fact, in the acquisition of the mother-tongue. In the acquisition of other languages the methods by which the vernacular is learned shou'd be followed as far as possible. Grammar, so far as it is required, should be simple, plain, and practical. Its theories should be kept in the back-ground; its terminology and principles should be the reverse of the abstract. The contrasts and comparisons involved between the strange and the familiar, will stimulate and guide to the first beginnings of reflective grammar. The memory for words should be exercised and stimulated. Choice tales, poems, narrative and lyric, should be learned for recitation. Natural history in all its branches, as contrasted with the objects before the eye—flowers, minerals, shells, birds, and beasts. These studies should all be mastered in the spring-time of life, when the tastes are simple, the heart is fresh, and the eye is sharp and clear The facts of history and geography should be fixed by repetition, and stored away in order.

But science of every kind, whether of language, of nature, of the soul, or of God, *as science*, should not be prematurely taught. For the consequense is, either disgust and hostility to all study on the one hand, or on the other, superficial thinking, presumptuous conceit, and, worst of all, sated curiosity The law of intellectual progress involves effort and dicipline severely imposed and constantly maintained, but the effort and dicipline should follow the guidance of nature.—*From Porter's Human Intellect.*