

live for only a very short time. And the individual with a variation better adapted to its surroundings than the remainder is the one which is most likely to survive. To quote Mr. Spencer's phrase, there will be a "survival of the fittest." Please note that I am not, at this moment, referring to variation, apart from the connection with natural selection, nor am I speaking of heredity. In a popular address the points must be dealt with one by one. It may not be out of place here to give Darwin's definition of natural selection in his own words. "This preservation of favorable individual differences and variations, and the destruction of those which are injurious, I have called natural selection." Every form of life has a congenital tendency to vary; these congenital variations are transmitted to the next generation, and marked changes are gradually produced. From analogy to the manner in which, by selective breeding, alterations are produced in domestic animals by man, nature may be described as selecting those forms which, varying advantageously, thereby survive, and propagate. Natural selection, however, does not suppose, as some people seem to imagine, any conscious selection upon the part of nature, but merely that existing conditions are taken advantage of. It is obvious, of course, that the congenital tendency to variation is really the keynote of natural selection, and our master, whose work I am attempting to describe, was very well aware of that fact. I will ask you to listen to a few of his remarks on selection. "It may metaphorically be said that natural selection is daily and hourly scrutinizing throughout the world the slightest variations; rejecting those that are bad, preserving and adding up all that are good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life. We see nothing of these slow changes in progress, until the hand of time has marked the lapse of ages, and then so imperfect is our view into long past geological ages, that we can only see that the forms of life are now different from what they formerly were." * * "What natural selection cannot do is to modify the structure of one species without giving it any advantage for the good of another species; and though statements to this effect may be found in works of natural history, I cannot find one case which will bear consideration." A very little thought will show the importance of this last remark. If it could be proved that animals or plants varied not for their own advantage, but only for the benefit of some other organism, a very serious difficulty would arise in accepting the theory of natural selection as the very basis on which it rests, would be undermined.

The ultimate result of natural selection will be, that by preserving and accumulating beneficial variations, each creature tends to become more and more improved in relation to its conditions. This improvement leads to the gradual advancement of the greater number of living beings throughout the world.

I have said that natural selection depends upon the tendency to vary which all organic life possesses at birth. Selection, as I have already mentioned, can only act by seizing

upon any variations which occur congenitally in animals and plants, and then transmitting those variations to their offspring. Whatever form, therefore, selection may take, the importance of variation is equally manifest. Variation is the starting point of the whole argument. Now, as this is the keynote of the arch of Darwinism, we must be absolutely assured of its existence, for without such assurance there can be no certain belief in the verity of Darwin's theory. If one is convinced of variation and heredity, natural selection follows as a necessary corollary. Darwin's book upon the subject of variation—he called it "The Variation of Animals and Plants under Domestication"—was begun in 1860, but was not published until 1868. This book contains an enormous number of facts illustrating variation, and, although it consists of two large volumes, I strongly advise the reader to forsake Hall Caine, Mrs. Burdett, Thomas Hardy, et hoc genus omne, until he has read this remarkable work. Anybody who has mastered it, will see what great importance Darwin attributed to variation, and how he appreciated the necessity of convincing his readers of its reality and extent.

The advantage of long thinking and pondering over his theory for twenty years before publishing his book, is well brought out by the poverty of the criticisms, as regards their novelty, passed upon the Origin of Species after its publication. Darwin himself was evidently struck by this, as shown by a letter of his to Lyell in September, 1860, in which he says: "Few things have surprised me more than the entire paucity of objections and difficulties new to me in the published reviews."

The enormous extent of variation in the vegetable kingdom is very strikingly brought out by one fact not generally known. It is that a flower garden as we know it, is comparatively speaking, a modern innovation. One of the earliest gardens in Europe—if not the first—was the little Botanical Garden, still existing at Padua, in Italy, formed in 1545. All the vast variety of flowers—both in form and color—which we see today have arisen from a very few simple forms during the past three hundred and fifty years—in other words, through an extraordinary amount of variation, and by natural selection, aided of late years by mankind adopting the process of artificial selection.

Variation is a fact beyond all dispute; but its causes are clouded in mystery. Darwin attacked the subject, but he felt the extreme difficulty of giving, with our present knowledge, any satisfactory solution of the problem. It would be out of place for me to say much upon this point here. I will ask the reader, however, in this connection, to note the influence of environment as linking together Darwin and Lamarck. I have already mentioned the importance attributed by Lamarck to environment upon animal development. Darwin, from his observations upon animals and plants under domestication, formed the opinion that even very slight changes in the conditions of life (that is, slight alterations in the environment) are often sufficient to cause variation; of these, excess of nutriment is one of the most exciting causes. He also concluded that the influences of environment accumulate, so that variation

may appear only two or three generations after exposure to them. The bearing of this point upon heredity will at once strike you, and it is a subject which, I think, has not received sufficient consideration. In a letter to Dr. Wagner in 1876, Darwin makes an admission concerning this matter. "In my opinion," he writes, "the greatest mistake I have committed, has been in not allowing sufficient weight to the direct action of environment, i. e., food, climate, etc., independently of natural selection."

While assuming that the environment may produce variation in an organism, the extent to which that variation will survive and persist will largely depend upon how largely it renders that organism better adapted to its environment as a whole. If the variation makes the individual more in harmony with its surroundings, it will aid in its preservation and perpetuation; if, on the contrary, the variation renders the individual less fitted to its environment, it will favor its destruction. It is an obvious truism that the preservation and survival of an organism depends on its being adapted to its surroundings. When that adaptation is perfect, the organism will remain stationary, and natural selection is at a standstill. But, as a matter of fact, the environment is perpetually changing; adaptation is continually being disturbed, and hence, natural selection is constantly in action. Now the beauty, accuracy, and completeness of the many adaptations in nature have been a theme for the wonder and the admiration of naturalists and philosophers from time immemorial. To take a few familiar examples—the eye for light; the ear for sound; the flower, and the bee, which assists in its fertilization; the color, or the shape of an insect, which, by simulating some other object, obtains protection from its enemies; the wonderful instincts of birds and ants—it is unnecessary to add more. Before Darwin brought forward this theory of natural selection, the commonly accepted explanation of all adaptations was that the adapted objects were specially designed for the position they were found to fill. It would be wast of time for men to enumerate the difficulties which this hypothesis involved. The explanation given by Darwin, upon the other hand, accounts for the most difficult cases. I dwell upon this point because so great an amount of this wonderful man's work demonstrated the adaptation in cases not easily understood at first. I have in mind his work upon Orchids; upon the Power of Movement in Plants; upon Cross and Self-Fertilization in the Vegetable Kingdom. It is the extreme completeness with which Natural Selection is able to explain all the innumerable adaptations of nature which has done so much to enable it, not only to entrench itself in the minds of the scientific world, but also to take hold of the popular imagination, although I feel very confident that many people have only a hazy idea of its meaning.

Darwin had seen from the first conception of his theory, as far back as 1838, that it would, as a necessary corollary, include men. On such an important point it is desirable to give his own words. "Although in the origin of species, the derivation of any particular species is never discussed, yet I thought it best, in order that no honorable man should accusæ