ADDRESS BY THE PRESIDENT.

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A CONSIDERATION OF SOME THEORIES OF EVOLUTION.

We find in the physical history of the earth an illustration of evolution in the modern sense of the word, a progress in accordance with fixed laws from the simple to the complex, from the undifferentiated to the differentiated.

That philosophical minds should suspect that the world of organic beings, animals and plants, had been the subject of a similar course of evolution is not strange; and we find that such a suggestion has been often and long ago made. In modern times Lamarck has led the way; but neither were his theories adequate, nor were the men of his time ready to abandon their ancient conceptions. But when, in 1859, Darwin and Wallace published the results of their independently pursued studies and proposed a theory, definite and supported by a multitude of facts, their works attracted immediate and sustained attention. It is doubtful if any doctrine so subversive of universally accepted ideas has ever, in so short a time, received the recognition of so many of the educated and thoughtful minds of the world.

The doctrine of organic evolution, which attempts to explain the various differences and resemblances which exist among organic beings, depends on two laws, *heredity* and *variability*. The one law ordains that the living thing shall possess the essential characters of its parent or parents; the other law that it shall depart from those characters to a greater or less extent. Neither law can be questioned by anybody; only the extent to which the one law prevails over the other is in dispute. The evolutionists maintain that the law of variability may prevail over heredity to such an extent that after a greater or less number of generations, the deviations from the original form and structure may be so great that a new species may be produced.

In the attempt to explain how it is that new species originate, Darwin and Wallace hit upon the idea of "natural selection." In nature no two individuals of a species are just alike. Each varies in some slight respect from the type. Of these variations, some may be indifferent, some useful, some harmful. According to these authors, these variations may affect all parts of the body, the form, the size and strength of single organs, color, or mental qualities. Again, all species tend to increase beyond the limits of space and food supply. From this latter cause there arises between the members of any species a struggle for existence. Moreover, all species are warred upon by many others, by which their food is appropriated and through which they themselves may be appropriated as food. In such a dire struggle it is, on the average, the best endowed individuals that will succeed in maintaining themselves and in producing offspring to inherit their useful characters; that is, the most vigorous individuals, those which have developed in the highest degree weapons of offense and defense, or protective colors, or the greatest cunning. The weakest, the most exposed, the most stupid, will perish and leave few or no young. From all the young produced by every species there is thus a constant and unsparing selection being made in favor of those individuals which can best endure the stress of the conditions. Hence the meaning of Darwin's phrase "natural selection," and of that used by Spencer, "survival of the fittest." Through the selection, for many generations, of the individuals possessing certain beneficial characters, these at length become fixed in the organization and strengthened until the organism is no longer what it was, but may have departed widely therefrom. Since success in the struggle is constantly demanding greater strength of limb and body, more efficient organs for each function, more weapons for assailing and repelling, more perfectly protective coloration, the general tendency of evolution has been upward; but the vigor with which the battle is waged may result in driving some species into such situations that degeneration may occur. Such are many burrowing animals and most parasites.

This process of natural selection is therefore quite similar to the artificial selection which is practiced by breeders in their effort to develop new varieties of animals and plants. Those individuals are selected which possess in the highest degree the desired quality; they are crossed with others having, if possible, the same quality, and the offspring of the pair are treated in the same manner, until the character sought is fully developed.

The rigorousness of the selective process that is going on in nature can hardly be appreciated by one who has not given attention to the matter. To a casual observer, it may appear as if the most worthless individuals got a living, while the better perished. The well-favored do often succumb, and in ordinary times the weak may escape; but when periods of great food-scarcity, or of intense heat or cold, or of drought come, then the weak perish miserably. The eggs produced by some fishes reach into the millions. Could each one develop into an adult fish, which should in its turn give origin to an equal number of offspring, a very few years would suffice to fill all the seas with that fish. As it is, only perhaps one egg in a million becomes an adult fish. The least protected eggs are swallowed by enemies, the weakest young fishes die from disease and exposure, while only the most vigorous escape.

Our wild rabbits produce several young at a litter and a number of litters each year; yet the number of rabbits does not, on an average, increase. As many rabbits must therefore die each year as are born, and they seldom die of old age. Dogs and men, extreme cold and hunger, carry them off by thousands. Is there not here abundant opportunity for the development of swiftness of foot, acuteness of eye and ear, and of endurance?

As long as the environment remains about the same, little or no change may occur in the structure or specific characters of animals; but the whole organization is kept up to the highest grade of efficiency. Should there, however, be a gradual change in the conditions under which any animal is living, there would come about a corresponding change in the animal itself. Should there, for example, be developed a gradual increase in the speed of our dogs, there would, I doubt not, occur a corresponding improvement in the swiftness of our rabbits. I can see no reason for supposing that natural selection would not have the same effect here as man's selection does in the case of trotting horses.

Darwin's theory of natural selection was based almost entirely on observations made on domesticated animals and plants. Organisms in a state of nature did not seem to him to be subject to such frequent and extensive variations. We are only now beginning to appreciate how numerous and how important these variations are. They do not affect in only a slight degree a single organ of one individual in a decade or a century, but probably every organ of every individual, and to a very appreciable extent. The proverbial unlikeness of the individuals of every species is due to this variation. Wallace, in his "Darwinism" has given us most impressive illustrations of this variation. Most of these illustrations have been drawn from the publications of our countryman, Dr. J. A. Allen, and relate to the winter birds of Florida. Allen made large collections and took accurate measurements of those portions of the body which are especially depended upon by naturalists in determining species, the length of body, wings, tail, tarsus, toes, and bill. All these parts were found to vary independently of one another, and the variations from the mean length often amounted to from 12 to 25 per cent. of the mean length. While, too, most of the parts measured were not far from the mean on each side, yet there were always a considerable number of individuals of each species that furnished measurements wide of the mean. The same principle is shown by Wallace to hold good among such lizards and mammals as have been studied. What is greatly needed is more extended observations among all classes of animals. I have examined some of our common snakes with reference to this matter of variation. We get the specific characters among snakes from the number of rows of scales across the back, the number broad plates along the abdomen and on the tail, and from the kind and arrangement of the colors. Anybody who has studied snakes has soon learned how extremely variable are their colors. Among specimens of the spreading adder, for example, may be found snakes of a plain gray or olive color without other markings, snakes with mere indications of blotches, snakes with most conspicuous spots of bright red or yellow and black, and snakes which are plain black. The other characters vary to a perplexing extent. What are merely individual, or at most, varietal peculiarities, have often furnished the basis for new species. In order to bring before you the range of the variations in important parts of these animals, I present the results of estimates which show how four species of our common snakes vary.*

These are the common garter snake (*Eutainia sistalis*), the black snake (*Bascanion constrictor*), the smooth, green snake (*Cyclophis vernalis*), and the ring-necked snake (*Diadophis punctatus.*) From these it appears that in the number of the body vertebræ the garter snake varies from the average to the extent of 14 per cent., the black snake 6 per cent., the green snake only 4.5 per cent. and the ring-necked snake 13 per cent. In number of caudal vertebrae, the garter snake varies 35 per cent., the black snake 20

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* The results here given have been deduced from the tables of measurements and counts of ventral and caudal plates given in Baird and Girard's "Serpents of North America." Any considerable collection of the species above studied would furnish still greater deviations from the means.

per cent., the green snake 23 per cent., and the ring-necked snake 23.5 per cent. In proportion of tail to body the garter snake varies 9.4 per cent., the black snake 28 per cent., the green snake 25 per cent., and the ring-necked snake over 35 per cent. There is scarcely a doubt that every character in each of these species will be found to be as unstable as those which have been studied. And it must be observed, too, that each of the characters varies independently of the others, so that we may get any combination that we may want. If breeders should find it to their interests to raise a varied assortment of black snakes they could, doubtless, by careful selection and crossing, produce short-bodied snakes with long tails, long-bodied snakes with short tails, or snakes extremely short or very long in both parts. Much more might we expect that natural selection, which has more abundant materials to work upon and unlimited time, should be able to produce varieties and species to suit the requirements of the changing conditions of geological periods.

While the main proposition of Darwin and Wallace that species arise from earlier species by descent with modification, has been almost unanimously accepted by the scientific world, a number of scientific authorities have, within recent years expressed more or less dissatisfaction with the prominence that Darwin and Wallace and their followers have given to the doctrine of Natural Selection as an explanation of organic evolution. This dissent has expressed itself in degrees from questioning whether or not natural selection has been the only factor concerned, to open declarations that it has had little or nothing to do with evolution. Of course, those who deny the efficiency of selection to transform species endeavor to find some other principles or forces which, in their estimation, act as efficient causes, and thus we are beginning to witness the evolution of various schools of evolution. And here it seems proper, as a matter of justice to Darwin, to deny that he, at least in his later works, maintained that natural selection is the only influence at work to bring about changes in organisms. One cannot read his works with even moderate attention without recognizing that he admitted the operation of the very forces and principles that many of these later evolutionists rely on to explain the phenomena of organic change. Only Darwin did not assign the same high value to these factors that some authors do now. Wallace, on the other hand, in his latest work advocates the earlier position of Darwin, and stands for what he calls the "overwhelming importance of Natural Selection over all other agencies in the production of new species."

Now, it matters not the degree of importance that we give to Natural Selection as a principle in organic evolution, it does not appear that we can regard it as furnishing a final solution of the phenomena to be explained. This objection has been justly urged: Natural selection acts only on characters which have been already produced and have become either useful or hurtful. By what means have they been produced? Before they can be selected they must exist; what principles or forces gave them their existence? It has been urged that if there are influences that can bring characters up to the stage where selection can begin to act on them, the same influences might continue to perfect them. Darwin saw the situation clearly. He says, in his "Descent of Man:" "With respect to the causes of variability, we are in all cases very ignorant, but we can see that in man, as in the lower animals, they stand in some relation with the conditions to which each species has been exposed during several generations." He then mentions, as some of the probable causes of change, the direct and definite action of changed conditions, the effects of increased use and disuse of parts, arrests of development, correlated variations, &c. Under such circumstances it becomes a legitimate subject of inquiry what those forces and conditions are which have been active in initiating changes in organisms, and what effect, if any, Natural Selection has had in perpetuating and accumulating these new characters and of repressing others.

One of the most recent and most thoroughly elaborated attempts to account for the variations of organisms is that of Dr. Aug. Weismann. It is presented in a series of lectures delivered between the years 1880 and 1890. The fundamental idea of his theory he has denominated "*the continuity of the germ-plasm*." All except the lowest animals are produced from eggs, which are essentially cells. When the egg is fertilized, it develops into an embryo by a process of division which leads to the production of an immense number of cells. These, becoming more and more differentiated in definite ways, form the tissues and organs of the adult being. Thus, from a simple egg there arises an animal which inherits the general features of the parent and even many of its minor peculiarities of form and habits. At some time during embryonic development there are separated from the other cells of the organism certain cells which in due season develop into eggs, as a provision for the continuation of the species. It appears hitherto to have been assumed that the materials of these eggs, or germ-cells, is derived by some process of transformation from that composing the ordinary, but not yet greatly modified, cells of the body. Dr. Weismann, on the other hand, maintains that the egg, or more exactly the nucleus of the egg, contains a substance, his *germ-plasm*, which possesses a peculiar chemical, and more especially molecular, structure, and which is the bearer of "the whole of the inherited tendencies of development." In the process of the development of the embryo, not all of this germ plasm is consumed in the construction of the body; but a small portion is set aside and remains in the body of the embryo unchanged, and destined to enter at the end into the formation of the eggs which shall give being to the next generation. The materials of the body cells Weismann calls *somatoplasm*, to distinguish it from the germ-plasm. The germ-plasm, although borne about in the body of the organism that in time will produce offspring, and though nourished by its somatoplasm, is wholly distinct from the latter, and is very slightly if at all affected by it. Weismann says of it: "The germ-plasm, or idioplasm of the germ-cell, certainly possesses an exceedingly complex minute structure, but it is nevertheless a substance of extreme stability, for it absorbs nourishment and grows enormously without the least change in its complex molecular structure." Weismann even maintains that this reproduction of the germ plasm without change may go on for thousands of years. He has compared the germ-plasm to a creeping rootstock which at intervals sends up a vigorous shoot. The shoot flourishes for awhile and dies, but the rootstock survives, to produce other shoots in indefinite number. The germ-plasm enjoys a sort of immortality.

The cause of heredity has always been a mystery. How is it that a cell which has not the slightest resemblance to the animal that produced it can go through a complicated series of divisions and transformations and at last gradually, but unerringly, reproduce even to minute details the structure and form of the parent? How is it that two eggs, indistinguishable from each other, but laid by different animals, developing perhaps under identical circumstances, can reproduce exact copies of their respective parents? Darwin attempted to give an explanation by assuming that each cell of any organism emits minute particles, called by him *gemmules*, which enter the germ-cells and become there representatives of the cells of the whole body. The germ-cells must according to this theory contain millions of gemmules. When development of the egg occurs the contained gemmules determine the reproduction of their respective cells in due order of time, place, and form. When any part of the body of the parent has undergone variation, this will be represented in the egg by the gemmules of the part and may thereby be inherited. The immense number of gemmules required to effect the results, as well as the lack of sufficient evidence of a positive kind in favor of Darwin's theory, have prevented its general acceptance.

On Weismann's theory, heredity follows from the assumption that both parent and offspring are derived from the same mass of germ plasm. That which had given origin to the parent must be expected to develop into a similar organism in the offspring. That the germ-plasm develops into the peculiar structure and form of both is due to its molecular structure, the result of gradual modifications which have been accumulating during the ages that have elapsed since their earliest ancestor received its being.

Some extremely important conclusions issue from the acceptance of this theory of Weismann's. If the germ-plasm, borne about in the body of any organism, protected and nourished by it, does not have its molecular constitution, on which the character of the offspring depends, at all affected by the state of the parent's body then none of what are called acquired characters can be transmitted from one generation to another. This fact, if fact it be, strikes at the very root of other promising theories. Then none of the results of the use and disuse of organs will be transmitted; none of the direct effects of the climate or soil, or any of the environment on the body of the parent, will show in the descendants; nor will any mutilations be inherited. The heat or the cold, the drought or the flood, may produce the most profound effects on the animal or the plant, in the way of altering its form or structure or color, but the offspring will not directly inherit any of these results.

Since, however, Weismann firmly believes that existing species have been derived from older species by descent and modification, how does he account for the variations that must have arisen? This is done on the theory of *sexual mixture*. The germ-plasm of every individual of every species has certain peculiarities, which are passed on, with greater or less intensity, to the next generation. The male animal or plant has certain hereditary tendencies, that of the female different tendencies. When the germ-cells of the two individuals have united, an organism develops that is different in some respects from both the parents, being, as Weismann expresses it, a compromise between the two developmental tendencies. Since the numbers of individuals of every species are numerous and no two are alike, new combinations of the germ-plasm are continually arising, and these express themselves in still other individuals which are different from any that have ever lived. Amid all these variations, which indeed will affect every organ, are some which are hurtful to the organism, and others which are advantageous. Such variations will come under the influence of natural selection, the individuals possessing hurtful variations being destroyed, those with advantageous variations being preserved and made the means of transmitting on to future generations the improvement. Organic evolution, then, according to Weismann, depends on two factors, variation brought about by sexual mixture, and natural selection. Indeed, according to him, the production of variations that may be inherited constitutes the whole significance of sex; it is simply a device of nature for the origination of variations through which natural selection may effect improvement. As a corollary from this proposition Weismann deduces the conclusion that any organisms which do not reproduce sexually, such as certain parthenogenetic insects and crustaceans, cannot undergo variation; and should their environment change to any considerable degree they must perish. However, since the publication of his lectures. Weismann has been compelled to recede from this position.

But if it be true that external influences have had nothing directly to do in bringing about inheritable changes in organisms, and if the species of one age have descended from more ancient species, how did the hereditary individual differences arise in the beginning? With most other evolutionists he believes that the Metazoa have been derived from the Protozoa. In the Protozoa, there is no reproduction by means of eggs. The animal is at once parent and egg. When reproduction occurs, it is usually accomplished by the division of the animal into two portions of equal size and similar form, so that it is impossible to say that either is parent or offspring. Each part reproduces in a similar way; and since there appears to be no reason why, in case the environment remains favorable, any of the products of division should ever die, Weismann regards them all as having potential immortality.

It must be remembered now that Weismann admits that external forces and conditions, as well as the use and disuse of organs, may affect profoundly the organization of even the higher animals, although he denies that any of the direct effects will be passed on the next generation. In like manner the *Protozoon* is influenced by external conditions and would have changes wrought in its body. Now since its *body* is at the same time the *reproductive element*, whatever modifications have arisen in the body would be inherited by the two portions into which it would divide. "If," says Weismann, "a Protozoon, by constantly struggling against the mechanical influence of currents in water, were to gain a somewhat denser and more resistant protoplasm, or were to acquire the power of adhering more strongly than the other individuals of his species, the peculiarity in question would be directly continued on into its two descendants, for the latter are at first nothing more than the two halves of the former." By the time, therefore, that some of the Protozoa, through more and more intimate association into colonies, by differentiations of the cells for the performance of different functions, and the production of germ-cells as distinguished from the body-cells, became modified into the primitive Metazoa, those individual differences had arisen which, constantly multiplied ever since by sexual mixture, have furnished the materials on which Natural Selection has worked to produce all the living animal forms that now exist.

It must be understood that, as regards the reproductive elements of the higher animals, Weismann contends for the continuity of the germ-*plasm*, not for that of the germ-*cells*. Embryology proves that the latter cannot be maintained. As Weismann says, "continuity of the germ-cells does not now take place, except in very rare instances." In certain insects there are, at the very beginning of development, a few cells separated from the others and afterwards received into the body of the embryo, in order later to develop into eggs. In some crustaceans, the germ-cells become distinct when about thirty cells have been produced. In vertebrates they do not usually become distinct from those composing the body until the embryo has been completely formed. Among the Hydroids, reproduction occurs largely by budding. The buds may develop into independent bodies, jelly fishes, which swimming away and attaining a large size, give origin to the germ cells. These do not make their appearance until after hundreds and thousands of cell-generations have been passed through. They arise originally from certain cells of the ectoderm, but make long migrations to the places where they finally undergo development into perfect eggs. Among plants, a fertilized ovule gives origin to an embryo. This may develop into a large tree, which finally will, at the tips of branches a hundred feet away, produce new ovules. Through millions of cells the germ-plasm must have made its way to reach those terminal buds. And the cells must contain this precious substance without showing its presence. Weismann says, "It is therefore clear that all the cells of the embryo must for a long time function as somatic cells; and none of them can be reserved as germ-cells and nothing else." How then does he explain the transferrence, through such long distances, of the germ-plasm? Referring to the Hydroids he says: "I concluded that the germ-plasm is present in a very finely divided and therefore invisible state in certain somatic cells from the very beginning of embryonic development, and that it is transmitted through innumerable cell-generations to those remote individuals of the colony in which the sexual products are formed."

But this transportation of the germ-plasm through so many generations of cells is by no means the only difficulty that besets Weismann's theory. There is a number of plants, among them the begonia, which may be propagated from pieces of the leaves. It would almost appear as if single cells of the leaf would reproduce the plant perfectly. Among the ferns it is no uncommon thing for new plants to spring from the surface of the leaves or of the stalks. Among mosses almost any cell of the root-hairs will develop into new plants. As pointed out by Strassburger, the germ-plasm must, in these cases, not merely travel through the plant to the *reproductive organs*, but be widely diffused throughout every part of the plant, and Weismann admits that this is the case. Similar phenomena occur among animals. If the fresh water *Hydra* is divided into two pieces, each will develop into a perfect *Hydra*. Trembly, in his experiments on these things, minced some of them into as small pieces as he could, and almost every piece developed into a perfect animal. It is stated that as many as forty were thus reproduced from a single one. When certain worms are cut in two, each part develops into a perfect individual. All animals show some power of reproducing lost and injured parts. How shall we explain these facts of reproduction and restoration? Is the restoration of the hydra due to the presence of germ-plasm or not? If it is claimed that it is due to the germ-plasm, it may be replied that it has not reproduced the animal, but only a part, that part which was missing, it may be the half of it or the greater part of it. When the worm is cut in two one cut surface may develop a new tail, the other surface a new head. Had the cut been made the thickness of a cell further forward, those cells that in the first case engaged in developing a new head would probably as readily have gone to work to produce a new tail. Does germ-plasm possess the power of reproducing the whole animal, or the head end or the tail end, according to circumstances? If the germ-plasm is concerned in these restorations of parts, we can hardly exclude it from other cases of restorations, and this will lead us to the admission that germ-plasm is present in nearly all the tissues of all animals. If the position is taken that the germ-plasm is not concerned in the cases that have been referred to, but some degraded product of germ-plasm, then we may say that such materials have powers curiously similar to those of germ-plasm itself, but even more wonderful. To what extent is the material of the cells of the cut surface of the worm different from that of germ-plasm itself, when those cells have the inherited power to produce either head or tail as demanded by the needs of the worm? If the molecular structure of germ-cells and of body-cells is so similar, is it impossible that some of the body-cells may undergo retransformation into germ-cells? Furthermore, whether this suppositious reproductive material is or is not concerned in the restoration of the minced hydra it must, if it exists at all, be present in all the cells. For, so far as we may judge, each hydra that has grown from a minute bit of hydra is capable of giving origin, when divided, to many new hydras, and these to others indefinitely. Since the last of such a series would, without doubt, be able to produce eggs the germ-plasm must have been contained in all the cells of all the series.

Weismann's conception is that the highly organized germ-plasm found in the nucleus is, after the first division, no longer what it was before, except that part which has been reserved,—is indeed no longer germ-plasm at all. At each subsequent division its structure becomes simpler as it gives origin to more and more complex tissues; that is, its energy runs down as it does work in forming tissues. He claims that, when the germ-plasm has thus become simplified, its character as germ-plasm can never be restored. It might be supposed that, if we could find any cells which, having once formed a part of any body-tissue, should take upon itself the powers of a reproductive cell, Weismann's theory would stand disproved. We then direct attention to the somatic cells of hydroids which develop into eggs. But Weismann accounts for this by supposing that the germ-plasm enters the cells and takes the place of the germ-plasm.

However, it appears to me that it must be admitted that the germ-plasm is so widely diffused through the tissues of many, if not all, organisms, and is so much like the substance of many other cells in its reproductive powers, as to make it doubtful whether there is any such distinct material. We may not be able to prove that it does not exist, but we may do as we do with other ghosts, prove the superfluousness of its existence. It is indeed a wonderful property that is possessed by the germ-cells of the animal, that of reproducing the form, organs, tissues, and millions of cells of the parent; but the cells that can reproduce the severed head of any animal, with its many sense organs, appear to me to possess a property even more wonderful. For the germ-cell has a structure and corresponding capacities which are the ingrained results of countless repetitions of the act of reproduction, while nothing of this kind can be said with regard to the cells which reproduce the head, or the tail, or the foot. It looks as if every cell of the whole body were originally endowed with the capability of reproducing all the others in due order; as if, indeed, something like Darwin's theory of pangenesis were really true. Through subsequent high differentiation of structure, or through unfavorable surroundings, the cells may not be able to accomplish the restoration, but they show that they possess at least a memory of their old duties.

In his last essay, that which treats of the transmission of acquired characters, Weismann reasserts strongly their non-transmissibility, be they produced in any way whatever. At the same time, he seems to me to introduce a new explanation of variation, and to make admissions which may prove fatal to his theory. It must be recollected that Weismann has been contending for the stability of the germ-plasm; that, in order to account for the variations that individuals show, he has invoked the agency of sexual mixture, which he regards as an invention of nature for that special purpose; that he has claimed that animals reproducing by parthenogenesis can undergo no adaptive changes. When speaking of the effect of external influences he says: "Without altogether denying that such influences may directly modify the germ-cells, I nevertheless believe that they have no share in the production of hereditary individual differences." He has just previously maintained that the transformation of a species can take place only through the accumulation of these individual differences. Now in the last essay, in discussing certain objections which have been urged against his doctrines, he contends that external conditions, light, heat, moisture, nutrition, and their opposites, can produce great changes in the body, but none directly in the germ-plasm. He grants, however, that the environment may act *indirectly* on the germ-plasm, so as to bring about important changes in the characters of animals and plants. He declares that he has never doubted the transmission of changes which depend on alterations of the germ-plasm. He then inquires: "And how could the germ-plasm *be changed* except by the operation of external influences, using the words in their widest sense?" To this we may reply, that he has hitherto attributed all changes to sexual mixture alone. If he is willing to admit that use and disuse of organs, changes in nutrition, and in the environment in general, may bring about modifications of organisms, he will not find it difficult to come to an agreement with many of his opponents, even if he does insist on postponing the results for a few generations. A few may insist that some characters acquired by the parent, for instance by the use of an organ, may be inherited by the next generation, but most persons would contend only that a predisposition to the reproduction of the character is inherited.

PAPERS READ.

CONDENSATION OF ACETOPHENONE WITH KETOLS BY MEANS OF DILUTE POTASSIUM CYANIDE. By ALEX. SMITH.

[ABSTRACT.]

It has been proven for some years that when benzaldehyde is boiled in dilute alcohol with a small quantity of potassium cyanide, two molecules of benzaldehyde unite to form benzoin. The present paper describes a class of cases where the same reagent has the power of causing the union of two bodies with the elimination of water—a condensation. The interaction takes place between a ketol such as benzoin, on the one hand and a ketone such as acetophenone on the other. For example benzoin and acetophenone in dilute alcoholic solution, in presence of a little potassium cyanide, yield on boiling desyl-acetophenone. (Jour. Chem. Soc. LVII, p. 643.)

$$C_6H_5—CO—\underset{\substack{|\\ C_6H_5}}{CH}—OH + CH_3—CO—C_6H_5 =$$

$$C_6H_5—CO—\underset{\substack{|\\ C_6H_5}}{CH}—CH_2—CO—C_6H_5 + H_2O$$

The interaction is now found to extend to other ketols. From cuminoin