V.—CONSCIOUSNESS AND BIOLOGICAL EVOLUTION. (II.)

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Sec. 1. In the article which has preceded this I spoke briefly of the two fundamental influences which we discover in all of organized life; of the influence which tends to restrict variation within certain typical lines, and of the influence which would lead the organism to break free from the restrictions thus presented.

I there spoke of the very beginnings of the appearance of these two influences in hypothetical simple aggregates: but the same two influences can be traced through the rising grades of life even until we reach the *quasi* organic social aggregates: for it is true as Prof. Knight has lately said¹ that "there is no doubt that the two factors in the historic evolution of the human race have been the power of the individual in leading the masses, and the power of the masses in controlling the individual."

The reader will of course realize that these influences which appear so diverse, as we view complex organisms objectively, are in fact both but aspects of the basic tendency to the persistence of life: they appear in opposition, because of the fact, which will become more clear in the sequel, that the tendency to strive for persistence of life is fundamentally *elemental*, and only secondarily relates to more or less integrated aggregates of elements.

But it is with these aggregates of more or less complex organic form that biology has to deal, and I believe that I shall not be misunderstood if for the sake of brevity I often refer to these divergent tendencies as we actually note them, without reiterated reference to their basic unity.

I shall not attempt here to trace the two influences through different forms, but shall discuss certain questions relating to the grand divisions of human capacity which these influences are efficient to produce.

¹ *Mind*, N.S. Jan. 1896.

I.

Sec. 2. Let us study first the influence which is restrictive of variation. The reader will at once recall that I would identify the effects of this influence in its broadest lines with instinct: for what I call instincts are those organized trains of activities which are determined to the attainment of biological ends. These two qualities, organization and movement towards some biological end, determine the actions of the individual in certain typical lines; and this is true whether the actions involved are fixed, as in reflex actions; or are more or less varied; or even if they are recognizable only by a general trend through an inextricable maze of utterly unpredictable reactions.

The point that I wish to emphasize in the first place is this, that the great mass of the instincts with which we are familiar may be broadly divided into three great classes, determined by three diverse types of biological ends. We have

1. The instincts which tend to render persistent the life of the individual.
2. The instincts which tend to render persistent the species to which the individual belongs.
3. The instincts which tend to render persistent the social aggregates formed by individuals in the higher processes of development.

1. Sec. 3. In those simplest of living masses which we may suppose to grow, and to multiply by fission, we must assume the existence of certain co-ordinated actions which relate to the absorption of nutriment. As simple organisms arise these co-ordinated actions must be continually existent, and as organisms become more and more complex, these co-ordinated activities although becoming correspondingly complex, must still retain their distinctive character.

As organisms develop we find another group of co-ordinated instinct actions leading to general expansive activities occurring upon the approach of what is usually advantageous to the organism; and still another group leading to a general shrinking, a hypernormal quiescence, occurring upon the approach of what is usually disadvantageous to the organism. A little later as organisms become active in their environment, we find co-ordinated instinct actions leading the organism to flee from the disadvantageous, to approach the advantageous, or to attack the disadvantageous: we also find developed many complex self protective reactions.

All of these types of instinct action of ancient lineage I have

attempted to show elsewhere¹ are discoverable in the higher animals, and in ourselves the highest type of living beings.

If the hypothesis of parallelism, as I hold it, be true, then all these instinct actions, involving pulses of neural activity in us, must involve pulses of psychic activity also: in other words they must be accompanied by what I have called "instinct-feelings." But most of these "instinct feelings" will not appear in consciousness, either because the neural systems which are coincidentally called into action are to a great extent disconnected from the brain system, or because the activities involved are so nearly fixed and definite that the psychic effects coincident with them will be unemphatic and will sink into that unanalysable complex which we call our empirical Ego.

But that these "instinct-feelings" do exist becomes clear when we consider that under certain conditions where we should expect them to appear in consciousness, they do so appear viz.: under conditions in which the whole organism is involved, or else under conditions in which the instinct actions although relatively fixed are called out only occasionally, and when called out must be emphatic if they are to be effective.

I have attempted to show elsewhere² that in such cases the "instinct feelings" gain a name and are called emotions: and that Joy, Sorrow, Dread, Relief are emotions of the type determined by the fact that the whole organism is involved; while Fear, Love, and Anger are emotions of the type determined by occasional and emphatic occurrence of the biologically valuable instinct actions.

But the special point that I wish to make clear here is that these instincts have individualistic import only, although of course they would never have been developed to the point reached in us had not the efficiency of the species become a part of nature's plan.

2. Sec. 4. Turning then to the instincts relating to the persistence of the species; it seems to me probable that they have been grafted upon these individualistic instincts, if we may so speak; and that the individualistic instincts have been specially developed in certain directions that happened to conduce to the persistence of the species.

It is true that rudimentary reproductive systems, and rudimentary sexual processes through which continuance of type is determined, are found very early in the development of animal life; still in these low organic types we note many

¹ See *Pain, Pleasure, and Aesthetics*.

² *Op. cit.*

forms of reproduction without sexual differences or relations; and many which are independent of conjugation between different individuals, parthenogenesis, hermaphroditism, and the like: and in certain types where sexual reproduction is possible, and sometimes where it is usual, we find it often replaced rhythmically or irregularly by non-sexual reproduction: in all such cases the individual is clearly self-dependent in relation to the propagation of its kind.

All this makes it appear probable that individual organic life, with inherent power of reproducing its own kind, long persisted before the slight advantage gained by sexual differentiation began to make the existence of different individuals of importance, and dependence of one individual upon another necessary, if the type were to persist. And during this long period the animal must have been self-dependent individually; in it must have arisen the germs of many instincts which related only to its own individual persistence. This is made clear when we note certain of the lowest types of organisms that can be examined under the microscope, which habitually reproduce their kind without conjugation of any sort, but which show nevertheless many differentiations of individualistic instincts.

When then sexual reproduction became important, the instincts relating to sex must have been formed out of, or in relation with, complex individualistic instincts already existing.

So far has this process been carried indeed that it is somewhat difficult to separate some of the individualistic instincts still existing in us, from the instincts relating to persistence of species with which they have become bound up: a notable instance of this is seen in the case of love; we can only become convinced that love is in its origin of individualistic import, by noting that we are able to be excited to love by persons with whom sexual desire cannot possibly be connected (*e.g.*, brothers and aged parents) and by non living objects (*e.g.*, knowledge) which have come to be of advantage to us.

I cannot stop to speak of those many complex instincts that relate less to sensual actions than they do to the protection of the young, to permanent mating, to the formation of the rudiments of family life. All of these instincts are later in appearance than those which relate to conjugation but nevertheless deal with the persistence of the species to which the individual belongs.

There is one point that I would specially emphasize here, for reasons to appear later; it is this; that in order to account for the formation of the instincts which relate to the persistence of

the species, we must assume that the instincts of purely individualistic import have become subordinated to these newly forming instincts of wider than individualistic significance: so that in the long run the individual would come to react under normal conditions to protect himself indeed as an individual, but only in such ways as would lead to the persistence of his species under these normal conditions.

The instinct feelings correspondent to the instinct actions spoken of in this section I shall not stop to treat further within the limits of this article.

3. Sec. 5. If we turn now to consider those instincts of a type which relate to the persistence of social groups I think we must grant also that these social instincts have been grafted upon the individualistic instincts, as thus subordinated to those which relate to the persistence of the species: in other words, we must agree that the individualistic instincts, as modified with relation to the persistence of species, have been specially developed in certain directions that happen to conduce to the persistence of social groups.

And here too the process has become so complex that it is difficult often to follow the threads used by Nature in the weaving. We recognize such instincts of social import however in the patriotic instincts, in the ethical instincts, in the benevolent instincts and in the art instincts, as I have elsewhere argued at some length in the work above referred to.

But here again the point that I would especially emphasize is this: that in order to account for the formation of the social instincts we must assume that the instincts of individualistic import, as subordinated to those instincts which relate to the persistence of species, must in their turn have become subordinated to the newly forming social instincts: subordinated so that in the long run the individual would, under normal conditions, come to react indeed to protect himself as an individual, in such ways as would also lead to the persistence of the species, but only in such manner as would lead to the stability of the social group to which he belongs.

Sec. 6. In what has preceded, I have studied instincts in three groups or classes; and the reader will agree with me, I think, that the instincts thus treated make up a very large proportion of those which we observe in our own lives and in the lives of animals.

But it would be incorrect to suggest that these great groups include all the instincts developed in the higher animals. The

so called "imitation instinct" may be mentioned as an example of an instinct which is not thus classifiable.

Possibly this instinct may be found to be merely the marked and complex development of a very fundamental mental and neural tendency, as Prof. J. Mark Baldwin appears to suggest: but it seems to me that the complex imitative tendencies which we recognize in our lives are of complex instinctive type, and are emphasized by Nature because she is able to use them for purposes of biological experiment in her vast laboratories: they do not appear to me to be identical in their essence with that "circular process" which Prof. Baldwin would have us call "imitation," and which he has shown to be determined, to a great extent at least in its beginnings, by self imitation.

I am free to confess however that I fail to note any large number of important instincts which cannot be included in one of the three great groups we have studied. I do recognize nevertheless a fourth class of which however few examples are prominent. This fourth class is made up of instincts which deal with the regulation of relations which it is advantageous to foster between the instincts already discussed.

A clear example of this type of regulative instinct is found in the "play instinct." Plays are occasioned by the diversion into certain relatively definite channels of surplus, so called "spontaneous," energies, which have resulted from hyper-nutrition, but which have been given no opportunity to express themselves in action. Nature has formed within us tendencies to divert these energies into channels that give practice in directions in which skill is, or will presently be, of value to us. It is a common-place that the plays of children make them ready for activities of after life: the girls' plays with dolls tell of future maternal activities: the boys' plays correspondingly tell of the world's battles he is to wage, often indeed reflecting the actual physical contests in which he would take part were he not held back from barbarism by the civilization in which he lives. In like manner the plays of mature men and women lead them to practice in directions which are likely to be advantageous to them in every day life.

I mention this fourth class here particularly because, as the reader will discover later, I shall endeavour to show that Nature has built up in us a most noble instinct of powerful force which cannot properly be placed in any of the three classes above described, but which I shall endeavour to show functions solely for the regulation of those relations existing between the instincts of these three classes which it is of the greatest advantage to emphasize.

Sec. 7. And now I wish to ask the reader to consider more in detail the matter of that subordination of one set of instincts to another set, of which I have above spoken. It is evidently important that this subordination of individualistic instincts to those relating to the persistence of the species, and of these two, in certain relations, to the social instincts:—it is important, I say, that this order of subordination should be conserved if the rise of social *quasi* organic aggregates is of biological importance. That this rise is of importance appears to be proven by the very existence of the social instincts: for it is exceedingly difficult to conceive how these instincts can have been formed, and once formed how they can have persisted, unless we suppose that the individual is indirectly better adapted to exist in his environment, and to perpetuate his kind, as a member of such a social group, than would have been the case had he not acted as a part of a social group by the subordination of his instincts in the order above described. The reader will find the point thus made to be of moment in the development of the argument in the next article of this series.

Of one more point I wish to remind the reader before turning from the study of the influences restrictive of organic variation. It must be apparent to him that the tendency to organic variation to be presently treated must on the whole be held in check, otherwise instincts could not be formed. In other words, the existence of instincts shows that typical actions have on the whole prevailed over variant actions in the development of the individuals of a race; that those individuals which subordinated their tendencies to vary, to those influences which led them to act in certain ways that have proved of value to their ancestors,—that those individuals have persisted and have left descendants who have proved able to hold their own in the contest for survival.

II.

Sec. 8. I shall now ask my reader to turn with me to consider the variant influence which we have noted to be as important in the evolution of organic life as the influence which tends to restrict variation.

In the first article of this series we considered certain questions of interest to both psychologists and biologists as they seemed to be more clearly defined in the light of the theory of neural and psychic parallelism.

In what follows I shall ask the reader to study with me, in relation to the same theory, a problem of especial interest to

the biologist, in the solution of which we may hope that psychology will some day offer some effective aid. I refer to the problem of the origin of those variations of organic forms which surround us and of which I have spoken so often in what has preceded this.

Sec. 9. I think all biologists will agree that if we postulate the existence in the dim past, of uniform undifferentiated living masses, there is no difficulty in conceiving of the appearance in them of variations, provided only they be acted upon by divergent forces. There is no more reason to doubt that variations would thus occur than there is to question the fact that inorganic elements will vary in reaction under like conditions of varying stimulation.

But if we find no serious difficulty in comprehending the origin of simple variation, we do find it no simple matter to divine the modes of occurrence of this variation in complex, differentiated, and yet integrated organic matter.

Now if biological actions of a certain type are parallel with what we know in consciousness, if mental effects are co-ordinate with physical effects in neural fields; if moreover biological variation be going on in our lives to-day; then that neural variation which is all important in higher life should be evidenced by psychic variation, and the mode of this variation might not impossibly be found reflected in some mode recognizable in our conscious life. It would seem possible then that an examination of psychological data might throw some light upon the problem of the nature and origin of the variations that perplex us. At all events it seems to me to be quite worth while for the biologist to turn to psychology and to enquire whether our science may not have a word to say to him on this subject.

Sec. 10. Let us turn our attention then to consciousness as we experience it in its most highly developed form, and look for its relations to variation. As soon as we do so we are struck by the fact that our mental life naturally divides itself, as by an inherent cleavage, if we may use the term, into the coincidents of instinct and of reason: instinct determining the existence in consciousness of impulses of one form or another; reason determining, in large part at least, processes which appear to inhibit or guide these impulses.

We are then forcibly led to the thought that instinct, and the impulses which it determines, are related to demands which are bound up with our organic nature, which determine our type; while on the other hand reason, and ratiocinative pro-

cesses, appear to be as distinctly related to real or attempted divergence from typical forms of action.

It seems to me that here we have a distinct leading, and that if the nature of reasoning process in relation to impulse be studied in connection with the biological problem which we are here considering, there is a large probability that some conclusions may be reached which will not be valueless to the student of living forms. And this is probably true whether the suggestions made in what is to follow have or have not any worth in this regard.

Now if we examine for a moment our mental experience in connection with those most complex impulses which we are accustomed to call the "higher" ones, viz. the ethical impulses, as these impulses are related to our reasoning, we are naturally led to recall in the first place the fact that these ethical impulses are dependent upon the existence of the organized social life in which we individual men and women are elements. Oppositions to murder, to theft, to adultery; impulses to benevolence and sympathetic aid; all alike would be functionless if each one of us existed in isolation from the social fabric.

In the second place it seems equally clear that at least a very large proportion of the actions which lead to the suppression of, or to divergence in, these impulsive demands of social import, have themselves relation only to ourselves as individuals; and that it would be impossible to hold for a moment that these actions inhibitive of the social instincts would be in like manner functionless if we happened to be leading a life uninfluenced by the existence of the social fabric. Murder, theft, adultery, hatred, envy and malice, all arise as individualistic tendencies, and foster individual efficiency.

We are then led to the position that in the *quasi* organic social life, variation from the typical forms which are represented by the ethical impulses is determined, to a great extent at least, by action on our part as though for the moment we were individuals without close bonds to this social life. We individuals who are elements in the social aggregate tend to vary from our social type when we act as individuals, as elements, without reference to the whole aggregate with which we find ourselves bound up.

This looks as though the action of an element of an aggregate, as an isolated entity, without reference to its position in the aggregate, might be of importance in the consideration of variation in general, and without further examination of the subject from the point of view just taken I shall ask the reader to turn with me to an objective consideration of the subject.

Sec. 11. I wish now to indicate as briefly as may be the evidence that variation from typical forms in complex organic life is determined, to a great extent at least, by conditions which lead elementary parts to act for themselves and not in relation to the aggregates of which they are elements.

In the sixth section of the first article of this series we considered the probable effect upon a simple aggregate of simple living masses if one element in the aggregate were affected by a special stimulus from the environment; and we concluded that under such conditions the element affected would tend *primarily* to react upon the disturbing force as though it were an isolated element; and that *secondarily* only would this action be modified, or inhibited more or less fully, by the influence of the other elements of the aggregate.

Here then we have in this hypothetical simple aggregate under such conditions a mass of elements, a large part of which act in some definite manner, but one of which acts differently under a special stimulus; and if we happened to view the aggregation as a whole we should express this fact by saying that one part varied. And it is to be noted that this variation means simply the action of one element of the aggregate as though it were without connection with the other elements.

Sec. 12. If now we substitute the word cell for the word element, in the section that has preceded this, we have a description of action in the lowest forms of what we call organic life. If we agree that the connection between the cells of the aggregate has become intimate and the relations of the actions of these cells therefore important; then we see that each cell that is specially acted upon from its environment will tend *primarily* to react upon the disturbing force as though it were an elemental cell, and *secondarily* only as though it were part of the aggregate; and it follows that if the disturbance from the environment be forceful, then the action as an isolated element will become more emphatic than the action as a part of the aggregate; and furthermore that if we look at the organic aggregate as a whole then we should be led to say that this particular element had varied. It is further to be noted that this tendency to variation will be modified by, and will be determined in a secondary way by, the closeness of relation, the integration, between the cell parts.

Sec. 13. I think I may take it for granted that the reader will follow my thought if for the sake of brevity

I make a great leap and take up now the consideration of the higher organic forms which are made up of parts which are themselves intimately integrated aggregates of cell life. Here I think we shall see that there is much evidence that variation from typical forms can be identified to a great extent with action of a special part as though it were an individual entity out of relation with the larger organic aggregate of parts of which it is in reality but one element.

In all the animals of higher grade we find specially differentiated organs, as we call them, which are employed in different functionings.

Now I wish to ask the attention of my reader especially to one point in reference to this differential functioning, which is of importance to our general argument. It seems clear that in an organism made up of differently functioning cells, or of differently functioning parts formed of aggregations of cells, the differentiated parts must have come to act, where the conditions are *normal*, in a manner which is best suited to their own perfect working; this normal action, however, at the same time being suited to the maintenance, under these normal conditions, of the life of the organism to which the differentiated parts belong. Let me explain this symbolically.

Let us suppose that in organism *A* formed of differentiated parts *a*, *b*, *c*, the normal functioning of *a* or of *b* or of *c*, to their own best advantage, does not produce results favouring the persistence of the whole organism *A*; but that on the other hand in organism *B*, formed of differentiated parts *a'*, *b'*, *c'*, the normal functioning of *a'*, *b'*, and *c'*, does produce results favouring the persistence of the whole organism *B*; then evidently organism *A* will be likely to be destroyed, while organism *B* will be likely to persist, and we shall have its differentiated parts *a'*, *b'*, *c'*, functioning normally as they would to their own best advantage as though the organism did not exist, and yet at the same time by this very functioning bringing about certain actions in the organism as a whole, which actions will, under normal conditions, tend also to result in the persistence of this organism.

The main point that I would ask the reader to note here is this, that each differentiated part of an organism under *normal* conditions acts, as it were, to its own elemental advantage. And although evidently the parts have been so modified that the action they would properly make for their own individual advantage as parts, will be best adapted to arouse such activities of the organism as a whole as will lead to the advantage of the organism rather than the parts;

still it is clear that this action in reference to the whole organism is of a secondary nature, if we may so speak.

But now I would ask my reader to consider what will happen if the stimuli reaching these differentiated parts should happen to be *abnormal*. Under such circumstances these parts, knowing (if I may be allowed so to speak) only of their own functioning, only of the demands upon them to react to these unusual stimuli, will tend first to act as though they had no relation to the whole organism; and only secondarily will their action be modified by the influence of the other parts of the organism which are drawn into unusual functioning as the result of the abnormal action of the part first affected.

Under conditions of morbid stimulation the heart will often undertake extraordinary work: this action may be modified by the influences from the rest of the organism sufficiently to prevent disaster to the organism itself; but on the other hand the excessive activity may, and not infrequently does, result destructively to the system as a whole, before this modification through systemic influences can take place.

The intestines in like manner will function with excessive vigour to throw off colonies of poisonous microbes; and, if the restraining influences from the organism are not effective, their action may bring death to the whole organism through the general exhaustion caused by their efforts to function for the advantage of their own special part.

Of course with the increase in integration, in interdependence of the parts, the tendencies to act as parts without relation to the rest of the organism becomes less marked and the influences from the organism become more quickly effective; but nevertheless it seems clear that the influence from the organism must always be secondary, and if the stimulus to the special part be sufficiently forceful there will always be danger that the influences from the organism will not be able to hold the elemental action in check.

The actions which I have above illustrated are accommodative actions, and the capacity to make such accommodations to abnormal conditions as those described must result in variations from the normal type. And the reader will note that if I am correct these variations from type are also explicable as due to action of elemental parts of a complex organic aggregate as though they were independent of the organism, and without relation to the part they normally play in the functioning of the organism as a whole.

Sec. 14. And now again I shall ask the reader to make with me a great leap; to consider those actions which imply

variation of individuals from the forms of action which are typical in our social life.

The reader will now recall the study we made in the first article of this series in reference to the conception of a social organism and he will remember that I there laid especial stress upon the limitations of this conception. I argued that although we are compelled to acknowledge that social life may be found to be organic in its nature, still it is very clear that if this *quasi* organic social life exist it must be of a type corresponding in integration to very low forms of individual organisms. And surely this lack in the social organism of that close integration between the individual elements that is so distinctly marked between the elemental parts of the higher animals, and which tends to limit or prevent variation in them, should lead us to expect to find in the social organism a very distinct tendency to variation from typical action in the lives of ourselves, who though individuals are elements of this hypothetical wider organic whole.

Now it is clear as we have already seen that in the evolution of normal individual life, the primary action in response to stimuli from without upon the cells, must have been subordinated to secondary actions tending to produce effectiveness of the individual, in case the two were not thoroughly adjusted to the same end. In like manner in the evolution of normal social life the response to the complex stimuli from without must be subordinated to secondary actions tending to produce effectiveness of the social complex, where the two sets of actions are not thoroughly adjusted to the same end. But it is also clear that where conditions are not perfectly normal in our social environment then, if our suppositions be correct, we should expect to find forceful stimuli tending to produce action in individuals as though they were disconnected altogether from the social aggregate, and this tendency to variance from the normal life of the social type should be expected to be the greater because of the slightly integrated form of this social organism of which we individuals are the elements.

I think it will be apparent to the reader without argument that we do show this tendency to variance from the social type marked out by our ethical instincts, and this variation will be found in great measure I think to be identical with our action as individuals, as it would be if we were totally isolated and not affected by social demands. Under the sudden and overwhelming appearance of extreme danger, as in the case of earthquake, the man will cower or flee, in answer to his individualistic self-preservative instincts, who would be not at

all slow under ordinary circumstances to act in answer to his social instincts for the protection of his tribe. A man if placed at bay may kill his comrade in self-preservation although ordinarily he would avoid such an act by means of restraints all of which have social import.

In other words, here again we find that variation from typical forms is determined by action of the elements (ourselves in this case) of an organic aggregate (the social body) as though they were isolated and had little or no dependence upon or relation to the aggregate as a whole.

It would be impossible within the limits of an article like this to stop to explain complex cases of reasoned variation which may not seem at first glance to fall within the general formula here suggested. I believe however that it will appear clear upon consideration that the ends which reason bids us keep in view in our variation in this regard are ends which would separate us from the order of that social life which in the past ages has been instrumental in the building up of the social, the ethical, instincts; and that our variant action thus in these cases also appears as determined by especially forceful stimuli to react as though we were isolated elemental parts, and without dependence upon the forces which would guide us if we acted exclusively in accord with the demands of that *quasi* organic social body to which we belong.

We are led to this view especially because we seem to be able to identify reasoning processes with the highest elaboration of the emphasis of environmental stimuli upon the individual who reasons. And if the thesis above defended be correct, the variation described in complex organic forms is determined partly indeed by the degree of integration existing between the members of the aggregate, but partly by the forcefulness of the stimulus which reaches the element from its environment; this latter being the efficient factor.

Now as we find in our highly differentiated life that in great measure the process of reasoning is that which determines our revolt against instinct, and our variations from the ancestral type; it seems highly probable *a priori* that we shall find ratiocination to be the conscious side of the latest development of the elemental variant process, and in the ensuing section I shall endeavour to give an argument which seems to me to corroborate this view.

Sec. 15. As we well know, there exists in all organisms, to speak first of the physical aspect, a balance of activities fitted to answer to environmental conditions; and furthermore (a) it seems clear that if one element of a complex organism alters its activity

in consequence of influence from without itself, this one alteration of one element will tend to effect alteration of the relation between the actions of all the elements of the organic system to which the changing element belongs. Furthermore (β) if this one element's tendency to alteration of the relation of its activity to that of the organism *persists* with sufficient strength, there may result a variation of the action in that organism from its ancestral type.

Now evidently this course of action must have its correspondents in the mental life that is coincident with the action, and I think that this same process can be shown to be effective in the higher mental life as we experience it. In correspondence with the action described under (α) above, it seems clear to me that if, in any case, one psychic element in a mental complex becomes hypernormally effective it will tend to restrict the natural psychic development of the mental complex to which it is attached; this natural development which is thus restricted being determined by inheritance or individual adaptation. Furthermore in correspondence with (β) above, it seems clear that if this effectiveness becomes *persistent* it will tend to alter the typical psychic development, which will take on another form than that which it would naturally develop in consequence of inheritance or previous adaptation. In other words, this action will tend to overpower instinctive, or *quasi* instinctive, leadings in favor of elemental variation.

This whole process on the physical side is determined, as appears above, by the persistence of the activity of some one physical element, and this persistence in turn may be held to be determined to a great extent by the *reduplication of the stimulus to action in an organ that is prepared to react efficiently*.

In the region of the correspondent mental development this means the reduplication of the stimulus to the recurrence of the idea which therefore becomes persistent and effective.

But on the psychic side the latest elaboration of the process of becoming persistent is apparently the same thing as the process of ratiocination. It consists in this.

It being recognised that a leads to x and that b leads to a ; it results that whenever b occurs, x follows, as happens also when a occurs. Hence the process of identification of the issues of a and b in x tends to a duplication of the stimulus to the resultant x and hence tends to the *persistence* of x .

But this process of the identification of the issues of a and b in x is the basis of the syllogistic form to which all ratiocination is reducible; viz. if a then x ; if b then a ; if b then x .

This argument therefore leads us directly to the statement that *ratiocination is the psychic aspect of the latest elaboration of the variant principle within us.*

Sec. 16. The suggestion then which it seems to me biology may gain from this special psychological view in reference to the nature of variation is that organic variation is probably due, in large measure at least, to the tendency of elements in organic aggregates to react as though they were isolated entities, rather than integral parts of a complex systematized unity; acting thus whenever the force reaching them from their environment is so emphatic that it overcomes the forces inherent in the organism of which they are elements, or compels reaction before sufficient time has been allowed for these organic forces to become effective.

The difficulties which appear when we attempt to express our complex life of apparent indeterminateness in terms of so simple a formula must not be overlooked: but on the other hand it must be remembered how numberless must be the systems within systems of integration which must affect the individual elements of a social body, which is determined by the aggregation of individuals like ourselves, each one of whom is moulded by such varied influences inherited from the past.

I have attempted thus at some hazard to present in outline an hypothesis by which we may state a great mass at least of the phenomena of organic variation in living bodies entirely in terms of what is known of the interaction of forces in the world in which these living bodies exist. If it appear that this hypothesis is not available I nevertheless am convinced that some other explanation than that here presented will be found that will enable us to account for these objective biological phenomena in terms of objective physical efficiency; and will render needless the subterfuge of the assumption of an extra-physical efficiency, whether this be expressed in the doctrine of special creations, or in that doctrine of interference by consciousness which we discussed in our first article, and discarded.

And if this explanation of variation in terms of physical efficiency be found, we shall then be thrown back to the mystery of life itself: to the problems connected with the origin and nature of assimilation and growth, of action and reaction: to the investigation of the causes which bring into existence that reverberant continuum in physical objects and in mental experience; that reverberant continuum which on the one hand we recognize in *life* and on the other hand in *consciousness*.