THE PSYCHOLOGY OF ATTENTION.

INTRODUCTORY.

PSYCHOLOGISTS have given much study to the effects of attention, but very little to its mechanism. The latter point is the only one that I propose to investigate in the following work. Yet even within these limits the question is important, for it is, as we shall later see, the counterpart, the necessary complement of the theory of association. If the present treatise contributes, however so little, to point out clearly this want of contemporaneous psychology, and to induce others to supply it, it will have accomplished its purpose.

Without attempting at present to define or to characterize attention, I shall take for granted that every one sufficiently understands what the term means. It is a matter of much greater difficulty to know at what point attention begins, and where it ends; for it embraces all degrees from the transient instant accorded 'to the buzzing of a fly, to the state of complete absorption. It will be conformable to the rule of a sound method only to study cases that are marked and typical; that is to say, those which present at least one of the foilowing two characteristics : intensity and duration. When both these coincide, attention is at its maximum. Duration alone reaches the same result through accumulation : as, for instance, when one de-

ciphers a word or a figure by the light of several electrical sparks. Intensity alone is equally efficacious : thus a woman will take in, in the twinkling of an-eye, the complete toilet of a rival. The feeble forms of attention can teach us nothing : at a.11 events, it is not from these that we must begin our study. Before we have yet traced the broad outlines of our work, it would be idle to note the more delicate aspects, and to waste time with subtile differences. The purpose of this series of essays is to establish and prove the following propositions :

There are two well-defined forms of attention : the one spontaneous, natural; the other voluntary, artificial. The former-neglected by most psychologists—is the true, primitive, and fundamental form of attention. The second-the only investigated by most psychologists-is but an imitation, a result of education, of training, and of impulsion. Precarious and vacillating in nature, it derives its whole being from spontaneous attention, and finds only in the latter a point of support. It is merely an apparatus formed by cultivation, and a product of civilization.

Attention, in these two forms, is not an indeterminate activity, a kind of "pure act" of spirit, acting by mysterious and undiscoverable means. Its mechanism is essentially *motory*, that is, it always acts upon the muscles, and through the muscles, mainly under the form of inhibition ; and as epigraph of this study we might choose the words of Maudsley, that "the person who is unable to control his own muscles, is incapable of attention. " Attention, under these two forms, is an exceptional, abnormal state, which cannot last a long time, for the reason that it is in contradiction to the basic condition of psychic life ; namely, change,

Attention is a state that is fixed. If it is prolonged beyond a reasonable time, particularly under unfavorable conditions, everybody knows from individual 'experience, that there results a constantly increasing cloudiness of the mind, finally a kind of intellectual vacuity, frequently accompanied by vertigo. These light, transient perturbations denote the radical antagonism of attention and the normal psychical life. The progress toward unity of consciousness, which is the very basis of attention, manifests itself still better in clearly morbid cases, which we shall study later under their chronic form, namely, the (fixed idea,' and in their acute form, which is ecstacy.

Already from this point, without passing beyond generalities, we are able by the aid of this clearly marked characteristic-the tendency toward unity of consciousness-to reach a definition of attention. If we take any adult person, in good health, and of average intelligence, the ordinary mechanism of his mental life will consist in a perpetual coming and going of inward events, in a marching by of sensations, feelings, ideas, and images, which associate with, or repel, each other according to certain laws. Properly speaking, it is not, as frequently has been said, a chain, a series, but it is rather an irradiation in various directions, and through various strata; a mobile aggregate which is being incessantly formed, unformed, and re-formed. Every one knows that this mechanism has been carefully studied in our day, and that the theory of association forms one of the solidest acquisitions of modern psychology. Not, indeed, that everything has been done; for, in our opinion, the part sustained by the emotional states has not been sufficiently taken into account as the latent cause of a great number of associa-

tions. More than once it happens that an idea evokes another, not by virtue of a resemblance which would be common to them in their character as ideas, but because there is a common emotional fact which envelops* and unites them. There would thus remain the task of reducing the laws of association to physiological laws, and the psychological mechanism to the cerebral mechanism that supports it; but we are still very far from this ideal point.

The normal condition is plurality of states of consciousness, or-according to the expression employed by certain authors — polyideism. Attention is the momentary inhibition, to the exclusive benefit of a single state, of this perpetual progression : it is a monoideism. But it is necessary clearly to determine, in what sense we use this term. Is attention a reduction to a sole and single state of consciousness? No ; for inward observation teaches us, that it is only a *relative* monoideism ; that is, it supposes the existence of a master-idea, drawing to itself all that relates to it, and nothing else, allowing associations to produce themselves only within very narrow limits, and on condition that they converge toward a common point. It drains for its own use-at least in the proportion possible-the entire cerebral activity.

Do there really exist cases of *absolute* monoideism, in which consciousness is reduced to a sole and single state entirely occupying it, and in which the mechanism of association is totally arrested ? In our opinion, this we meet in only a few, very rare cases of ecstacy, which we shall analyze later on ; still it is for a fleeting instant only, because consciousness disappears when

*See good instances in J. Sully: " Illusions," Chap. VII

placed beyond the conditions that are rigorously necessary to its existence.

Attention (we here once more and for the last time recall the fact, that we shall only study the clearest cases) consists accordingly in the substitution of a relative unity of consciousness for the plurality of states, for the change which constitutes the rule. Yet this does not suffice to define attention. A very bad toothache, a nephritic colic, or intense enjoyment produce a momentary unity of consciousness, which we do not confuse with attention proper. Attention has an object ; it is not a purely subjective modification : it is a cognition, an intellectual state. This is an additional characteristic to be noted.

This is not all., To distinguish it from certain states which approach it, and which will be studied in the course of our work (for example, fixed ideas), we must take account of the adaptation that always accompanies it, and which,. as we shall attempt to establish, in a great measurk constitutes its character. In what does this adaptation consist ? For the present, let us limit ourselves to an entirely superficial view.

In cases of spontaneous attention, the whole body converges toward its object, the eyes, ears, and sometimes the arms ; all motions are arrested. Our personality is captured, that is, all the tendencies of the individual, all his available energy aim at the same point. The physical and external adaptation is a sign of psychic and inward adaptation. Convergence is a reduction to unity substituting itself for that diffusion of movements and attitudes which characterizes the normal state.

In cases of voluntary attention adaptation is most

frequently incomplete, intermittent, without solidity. The movements are inhibited, yet to reappear from time to time. The organism converges, but in a languid, reluctant sort of way. Intermissions of physical adaptation are a sign of intermissions of mental adaptation. The personality has been only partly won, and at intermittent moments.

I must ask the reader to pardon the circumstance that these brief remarks are somewhat obscure and insufficient. Details and proofs will come later. It was merely a question of paving the way for a definition of attention which, I believe, I can present in the following form: "It is an intellectual monoideism, accompanied by spontaneous or artificial adaptation of the individual." Or, if we prefer another formula: "Attention consists in an intellectual state, exclusive or predominant, with spontaneous or artificial adaptation of the individual."

But let us now leave the foregoing generalities, in order to study, in their mechanism, the several forms of attention.

CHAPTER I.

SPONTANEOUS ATTENTION.

SPONTANEOUS attention is the only existing form of attention until education and artificial means have been employed. There exists no other kind in most animals and in young children. It is a gift of nature, but very unequally distributed among individuals. Still, whether strong or weak, everywhere and always ***it is caused by emotional states.*** This rule is absolute, without exception. Man, like animals, lends his at-

tention spontaneousiy oniy to what concerns and interests him ; to what produces in him an agreeable, disagreeable, or mixed state. As pleasure and pain are only signs that certain of our tendencies are being satisfied or crossed; and as our tendencies are what is deepest in us ; as they express the very depths of our personality, of our character ; it follows that spontaneous attention has its roots in the very basis of our being. The nature of spontaneous attention in any person reveals his character, or, at least, his fundamental tendencies. It tells us, whether a person is frivolous, vulgar, narrow, open, or deep. The janitor's wife will spontaneously lend her whole attention to the gossip of her neighbors ; the painter to a beautiful sunset, in which the peasant only sees the approach of night; the geologist to the stones he chances to find, in which the uninitiated only see worthless pebbles. Let the reader look into himself and around him ; the examples are so easily found, that it is useless to dwell longer upon them here.

It might be a subject of wonder that so evident and striking a truth (for spontaneous attention without an anterior emotional state would be an effect without a cause) should not long ago have been recognized as a common acquisition of psychology, if indeed the majority of psychologists had not obstinately persevered in the exclusive study of the higher forms of attention, that is to say, in beginning at the end.* It is highly necessary, on the contrary, to dwell upon its primitive

* The psychologists who have clearly seen the importance of the emotional states in attention, are so few, that I am only able to quote Maudsley, "Physiology of Mind," Chap. V; Lewes, "Problems of Life and Mind," Vol. III, p. 184 Carpenter, "Mental Physiology," Chap. III ; Horwiez, "*Psychologische Analysen*," Chap. I, and a few of Herbart's disciples, particularly. Volkmar, "*Lehrbuch der Psychologie*," Vol. II, Sec. 114.

form : without the latter nothing is intelligible, nothing explainable, everything is vague, and we should remain without the guiding thread of our study. Accordingly, we shall not hesitate to multiply the number of our proofs.

Any man or animal,, hypothetically incapable of experiencing either pleasure or pain, would be incapable of attention. There could only exist for him certain states more intense than certain other ones, which is an entirely different matter. It is accordingly impossible to maintain, in the same sense as Condillac, that if amid a multitude of sensations, there is one that predominates by its intensity, it is therewith "transformed into attention." It is not intensity alone that acts, but, above all, our adaptation, that is to say, our tendencies, as they happen to be crossed or satisfied. Intensity is but an element, and oftentimes the least important. Thus we may observe how spontaneous attention is natural and devoid of effort. The idler, who loafs around in the street, will stare with gaping mouth at a procession or passing masquerade, and preserve perfect imperturbability so long as the procession lasts. If at any time effort appears, it is a sign that attention changes in character, that it becomes voluntary, artificial.

In the biographies of great men, traits abound, which prove, that spontaneous attention entirely depends upon emotional states. These traits are the best, because they show us the phenomenon in all its force. Instances of great attention are always caused and sustained by great passions. Fourier, says Arago, remained turbulent and incapable of application until his thirteenth year: he was then initiated into the elements of mathematics, and forthwith became a dif-

ferent man. Malebranche, by chance, reluctantly takes up Descartes's treatise "*de l'Homme*"; the perusal of it "caused such a violent beating of the heart that from hour to hour he was compelled to lay the book aside, and break off its perusal, in order to breathe freely"; and he becomes a Cartesian. It is useless to speak of Newton, and many others. Some perhaps will say: Such traits are the marks of a dawning vocation. But what indeed is a vocation but attention, discovering its way, its true bearings for the rest of life? No finer instances of spontaneous attention could be given, for this form does not last for only a few minutes or an hour, but forever.

Let us examine a different aspect of the question. Is the state of attention continuous? Yes, apparently so; but in reality, it is intermittent. "What is called giving attention to one thing, is, strictly speaking, the following a series of impressions or connected ideas, with an ever renewed and deepening interest. For example, when we witness a dramatic representation.. . . And even a prolonged attention to a small material object, as a coin, or a flower, involves a continual transition of mind from one aspect to another, one set of suggestions to another. Hence it would be more correctly described as making the object the *centre* of attention, the point from which it sets out and to which it continually reverts." *

Researches in psycho-physics, of which we shall speak later (Chap. II, Sec. 4), show that attention is subject to the law of rhythm. Stanley Hall, while studying with great care the gradual changes of pressure produced upon the tips of the fingers, has established the fact, that the perception of continuity seems impos-

*J. Sully, Outlines of Psychology. Chap. IV.

sible, and that the subject cannot have the feeling of continuous augmentation or decrease.

Attention chooses between different degrees of pressure, in order to compare them. Certain errors in the notation of astronomical phenomena are also due to these oscillations of attention. *

Maudsley and Lewes have compared attention to a reflex motion; it would be more proper to say, a series of reflexes. Any physical excitation produces a movement. Similarly a stimulation coming from the object produces an incessantly repeated adaptation. Deep and tenacious cases of spontaneous attention have all the characteristics of unassuaged passion, which unceasingly re-commences in the effort to satisfy itself. The dipsomaniac, before a filled glass, will swallow its contents; and if some malignant fairy, as soon as it was emptied, refilled it, he would never stop. Erotic passion acts in like manner. Vicq d'Azyr maintained that monkeys could not be trained, because they cannot be made attentive (which in the first place, is not true). To this Gall retorted : Show a monkey its female, and you will find out whether it is capable of attention. When confronting any scientific problem, the Newtonian mind acts in the same manner ; it falls a prey to a perpetual irritation, which holds it in its power without cessation or rest. No fact is clearer, more incontestable, more easily verified than this, namely, that spontaneous attention depends upon emotional states, such as desires, satisfaction, discontent, jealousy, etc. ; its intensity and its duration depend upon their intensity and their duration.

Let us here note a fact of considerable importance

*"American Journal of Psychology," 1887, No. 1. "Philosophische Studim," 1888, Vol. V, p. 56, and following.

in the mechanism of attention. This real intermission in an apparent continuity alone renders possible any long attention. If we keep one of our eyes fixed upon any single point, after a while our vision becomes confused; a cloud is formed between the object and ourselves, and finally we see nothing at all. If we lay our hand flat upon a table, motionless, and without pressure (for pressure itself is a movement), by slow degrees the sensation wears off, and finally disappears. The reason is, that there is no perception without movement, be it ever so weak. Every sensorial organ is at the same time both sensitive and motory. As soon as absolute immobility eliminates one of the two elements (motility), the function of the other after a while is rendered null. In a word, movement is the condition of the change, which is one of the conditions of consciousness. These well-known facts, of common experience, make us understand the necessity of these intermissions in attention, often imperceptible to consciousness, because they are very brief, and of a very delicate order.

II.

THE physical manifestations of attention are numerous and of very great importance. We shall minutely pass them in review, while forewarning the reader, that we consider them less as effects of this state of mind, than as its necessary conditions-frequently even as its constitutive elements. This study, accordingly, far from being subordinate to our purpose, is really an investigation of capital importance. To obtain an approximately clear idea of the mechanism of attention, we shall not have to look anywhere else. It is, in fact, only an attitude of the mind, a

purely formal state; if we divest it of all the physical concomitants that determine and give it substance, we remain in the presence of a pure abstraction, a phantom. And so the psychologists that have only spoken of attention from inward observation, have remained silent concerning its mechanism, and have limited themselves to extolling its power.

It is always necessary to bear in mind the following fundamental principle : Every intellectual state is accompanied by definite physical manifestations. Thought is not,-as many from tradition still admit,—an event taking place in a purely super-sensual, ethereal, inaccessible world. We shall repeat with Setchenoff, "No thought without expression " ; that is, thought is a word or an act in a nascent state, that is to say, a commencement of muscular activity. The sensorial forms of attention so clearly testify to this principle that it cannot be questioned. The same applies to that internal, hidden process, called reflection, of which we shall speak later.

The physical concomitants of attention can be referred to three groups : vaso-motor phenomena, respiratory phenomena, and motory phenomena, or phenomena of expression. They all denote a state of convergence of the organism and of concentration of labor.

I. Let us suppose that twenty persons fix their attention for five or ten minutes upon their little finger. In such case something like the following will happen. Some will be unconscious' of any sensation whatever ; others will experience certain distinct sensations, as suffering, pain, arterial pulsations;, the majority will feel a faint impression of heaviness and a crawling sensation. This simple experiment raises the following questions: Do there not always exist in the several

parts of the body sensations, due to incessant modifications of the tissues-modifications which pass by unperceived unless attention is fixed upon the same? Can the act of attention increase the vascular activity of the sensorial ganglia, and there produce subjective sensations ? Finally, can the sympathetic centres be aroused, can the vaso-motory nerves be so influenced as to produce certain transitory vascular modifications in the finger with which the sensation is connected ?

The first supposition seems probable only to a very slight degree. Indeed, it is always possible to experience a sensation in the finger, if we set about attentively to seek for this sensation.

But, we think that the two other suppositions are perfectly well grounded. The sensation experienced is perhaps partially subjective ; but in our opinion, the finger, upon which thought is concentrated for a sufficient space of time, is really the seat of a sensation. The vascular modifications that take place, are felt in the form of arterial pulsations, heaviness, etc. *

It is highly probable, and almost universally admitted, that attention, even when not directed toward any region of our body, is accompanied by local hyperhæmia of certain parts of the brain. The vascularization of the parts concerned, increases in consequence of greater functional activity. This local hyperhæmia is caused by a dilatation of the arteries, which itself is caused-by the action of the vaso-motor nerves upon the muscular integuments of the arteries. The vaso-motor nerves depend on the great sympathetic nerve, which is independent of the action of the will, but which is subjected to all the influences of the

*Hack Tuke, "Mind and Body," p. 2

emotional states. The experiments of MOSSO, among others, show that the slightest and most transient emotion causes an afflux of blood to the brain. "There is," says Maudsley, "a more active circulation of blood through the brain during function than when it is in repose. We may fairly conclude, then, that the effect of attention to a current of thought is to quicken the circulation in the nervous substrata which minister to it; not otherwise than as when some earnest thought has taken hold of the mind, it keeps up an active circulation in the brain, and will not let us go to sleep."* After a spell of protracted attention we may also notice the redness (sometimes the pallor) of the face.

II. The respiratory modifications which accompany attention resemble the motor phenomena proper, and enter partly into the feeling of effort. The rhythm of respiratibn changes, slackens, and sometimes undergoes a temporary stoppage. "To acquire the power of attention," says Lewes, "is to learn to make our mental adjustments alternate with the rhythmic movements of respiration. It is a felicitous expression, that in the Frenchlanguage, which designates a clever but superficial thinker, as one incapable of any work *de longue haleine*—of long breath."? The yawning which follows a protracted effort of attention is probably the effect of the slackening of respiration. Often, in like instances, we produce a prolonged inhalation, in order to renew abundantly the air within our lungs. The sigh-another respiratory symptom-as several authors have pointed out, is common to attention, to

* **Maudsley**: "**Physiology of Mind.**" Gley: *Sur l'etat du pouls carotidien le travail intellectuel.*

† Consult **Lewes,** loc. **cit.,** p. **188.**

physical, and moral pain : its object is to oxygenize the blood that has been narcotized by the voluntary or involuntary stoppage of respiration.

All these facts are so many proofs in support of what has been said before, that attention is an exceptional, abnormal fact, which cannot last a long time.

III. The movements of the body, which are said to express attention, are also of paramount importance. In this chapter we can only enter into a partial study of the same ; the remainder will be more properly studied under the title of voluntary attention:* but here, for the first time, we shall proceed to investigate the motory mechanism of attention.

In the first place let us examine the facts. They have not been seriously studied before our own time. Formerly only artists and a few physiognomists—both at all times too partial to their own fancies-had concerned themselves about them.

Duchenne, of Boulogne,-a pioneer in this as in various other fields,-conceived the idea of substituting the experimental method for the pure observation practiced by his predecessors, Ch. Bell, Gratiolet, etc. Ey the aid of electricity he provoked the isolated contraction of a facial muscle of a man affected with anæsthesia, and by means of photography he obtained the results of the experiment. According to the theory which he had set forth in his *Mécanisme de la physionomie humaine* (1862), a slight contraction of a single muscle is often sufficient to express an emotion ; every emotional state produces a single local modification. Thus, according to him, the occipito-frontalis is the muscle of attention ; the orbicularis superior of the eye-lids, the muscle of reflection; the pyramidal, the muscle of

*see Chap. II, *infra*.

menace; the zygomaticus major, the muscle of laughter ; the eye-brow-muscle, the muscle of grief; the triangular of the lips, the muscle of contempt ; and so on. Still, Duchenne limited himself to stating merely the facts ; in this following the example of J. Miiller, who declared that the expression of the emotions is a completely inexplicable fact. Darwin went still further., Making use of the comparative method, and relying upon laborious researches, he investigated the origin' of the different mechanisms of expression ; he tried hard to establish why the contraction of a certain given muscle of the face, is necessarily associated with a certain given state of mind.

In the absence of these minute. investigations all attempts to explain the mechanism of attention would have been premature. How, indeed, is it possible to explain a mechanism, the wheel-work of which is unknown to us ? Let us see, in a summary way, what we know concerning attention in its two forms ; as applied to external objects (attention proper), or to internal events (reflection).

Attention (in order to mark it more precisely, we shall call it sensorial) contracts the occipitio-frontalis. This muscle, which occupies the whole region of the forehead, has its mobile point of insertion in the under surface of the skin of the eye-brow and its fixed point of insertion at the back part of the skull. In contracting, it draws to itself the eyebrow, lifts it, and produces a few transversal wrinkles on the forehead; consequently the eye is wide open and well illuminated. In extreme cases the mouth opens wide. In children and in many adults close attention produces a protrusion of the lips, a kind of pouting. Preyer has attempted ta explain this facial play by hereditary in-

Auence. "All animals," he says, "first direct their attention to the search for food. The objects that their lips, their feelers, their proboscis, and their tongue can reach, are those with reference to which their first investigations are made. All examination of, and all search for, food, consequently, is accompanied by a preponderative activity of the mouth and of its appendants. In suckling, the mouth of the infant protrudes forward." In this manner an association would be formed between the first movements of the mouth and the activity of attention.

The act of reflection is expressed in another, and almost contrary manner. It acts on the superior orbicular muscle of the eye-lids and lowers the eye-brow. As 'a consequence, small vertical folds are formed in the space between the eye-brows : the eye is veiled or completely closed, or it looks within. This wrinkling of the eye-brows imparts to the face an expression of intellectual energy. The mouth is closed, as if to sustain an effort.

Attention adapts itself to what is without, reflection to what is within. Darwin explains by an analogy the mode in which reflection expresses itself. It is the attitude of difficult vision, transferred from external objects to internal events that are difficult to grasp. * Hitherto we have only spoken of the movements of the face; but there are, besides these, those of the entire body-of the head, trunk, and limbs. It is impossible to describe them in detail, because they vary with each animal species.-/- In general a state of

*For details see : Darwin, "Expression of the Emotions," Chap. X; Preyer, "The Mind of the Child," p. 250, et seqq.; Montegazza, "*La physionomie*," Chap. XVI.

† An excellent study of the expression of attention in animals will be found in Ricardi, "*Saggio di studi e di osservazioni interno all' attenzione nell' uomo e negli animali.*" Modena, 1877, (second part, p. 1-17).

immobility sets in, adaptation of eyes, ears, and of touch, as the case may happen : in a word, there is a tendency toward unity of action-convergence. Concentrationof consciousness, and concentration of movements, diffusion of ideas and diffusion of movements go together. Let us recall the observations and. calculations of Galton upon this subject. He observed an audience of fifty persons, listening to a long and tiresome lecture. The number of movements clearly discernible in the audience was very uniform : forty-five a minute, or, say an average of one movement for each person. Several times, the attention of the audience having been aroused, the 'number of movements decreased by one half; besides they were less extended, less prolonged, shorter and more rapid. I may incidentally anticipate an objection. Everybody knows that attention, at least, in its reflected form, is at times accompanied by movements. Many people seem to find that walking to and fro helps them out of perplexity; others strike their forehead, scratch their head, rub their eyes, move their arms and legs about in an incessant, rhythmical fashion. This, indeed, is an expenditure, not an economy of motion. But it is a profitable expenditure. The movements thus produced are not simple mechanical phenomena, acting upon our external surroundings; they act also through the muscular sense upon the brain, which receives them as it receives all other sensorial impressions, to the increase of the brain's activity. A rapid walk, a race, will also quicken the flow of ideas and words; they produce, as Bain says, a sort of mechanical intoxication. The experimental researches of M. Féré, which we cannot quote here,* furnish nu-

* See his book, "Sensation and Movement."

merous instances of the dynamogenetic action of movements. We stretch out our arms and legs to begin work ; that is, we arouse the motor centres. Passive movements impressed upon paralyzed members, have in certain cases, been able, by reviving motory images, to restore lost activity. And it is to be observed, that the result of these movements is to increase mental activity, and not to concentrate the attention; they simply provide it with subject-matter. It is a preliminary operation only.

We must now determine the real part sustained by the movements in attention. Up to this point we have limited ourselves to describing them-at least the principal ones ; we are now prepared to put the question in its clearest and simplest terms :

Are the movements of the face, the body, and the limbs, and the respiratory modifications that accompany attention, simply effects, outward marks, as is usually supposed ? Or, are they, on the contrary, *the* **necessary** *conditions, the constituent elements, the indispensable factors of attention ?* Without hesitation we accept the second thesis. Totally suppress movements, and you totally suppress attention.

Although for the time being we are in a position only. partially to establish the point maintained (the study of voluntary attention, reserved for an other chapter, will show it to us in a new aspect), still since we are now touching upon the essential feature of the mechanism of attention, it seems proper to dwell awhile upon the subject.

The fundamental rôle of the movements in attention is, to *maintain* the appropriate state of consciousness and to reinforce it. But as this is a question of mechanism, it will be preferable to approach the

problem from its physiological side, by an inquiry into what takes place in the brain, in its double capacity of an intellectual and a motory organ.

1. As an intellectual organ the brain serves as substratum to perceptions (in sensorial attention), images, and ideas (in reflection). By hypothesis, the nervous elements that act will furnish, on an average, a superior work.

Attention certainly causes an intense innervation, as proved by the numerous experiments of psychometry, in which it plays a part. "An active idea," says Maudsley, "is accompanied by a molecular change in the nervous elements, which is propagated either along the sensory nerve to its periphery, or, if not so far, at any rate to the sensory ganglion, the sensibility of which is thereby increased. The result of this propagation of molecular action to the ganglion is that the different muscles in connection with the affected sense are put into a certain tension by reflex action, and thereby increase the feeling of attention, in accordance with the law that associated feelings strengthen one another."* Attention, according to Hartmann, "consists in material vibrations of the nerves," in a nerve-current, which, traversing the sensible nerves, proceeds from centre to periphery.† But there is another element of equal importance.

2. As a motor organ the brain plays a complex rôle. In the first place, it inaugurates the movements that accompany perceptions, images, or ideas; afterwards, these movements, which frequently are intense, return to the brain by way of the muscular sense as sensations of movements; the latter increase the

*Loc. cit., p. 313.

†*Philosophie de l'inconscient, trad. Nolen*, Vol. I, p. 145; Vol. II, p. 65

quantity of available energy, which on the one hand serves to maintain or to reinforce consciousness, and, on the other, returns to its original starting-point in the form of a fresh movement.

In this manner there is a constant going and coming from centre to periphery, from periphery to centre, and from the strengthened centre again to periphery, etc. The intensity of consciousness is but the subjective expression of this complicated work. But to suppose that this state could last without these organic conditions, is an untenable hypothesis, completely in disaccord with all that experience teaches us. The naïve spectator at the Opera, who is bored at the unintelligibility of the music, is all attention when a sudden change of scenery occurs; that is, when the visual impression has produced an instantaneous adaptation of the eyes and the whole body. Without this organic convergence the impression would rapidly vanish. "The difference between attention and voluntary movement," says Wundt, ('consists essentially in the preponderant reaction upon the sensitive parts (the original source of the performance). In voluntary movement, the main direction of the central excitation is toward the muscles; in attention, the muscles only act in conjunction with subordinate, sympathetic movements" ;*or, in other terms, a reflection of movements is produced. Finally, in the words of Maudsley, we may declare the mechanism of attention to be : "first, the excitation of the proper ideational track either by external presentation or internal representation ; secondly, the intensification of its energy by the increment of stimulus resulting from the

* *Physiologische Psychologie*, pp. 723–724 of the first edition. This passage is not found in the following editions.

proper motor innervation ; thirdly, a further intensification of energy by the subsequent reaction of the more active perceptive centre upon the motor factor—the interplay of sensory and motor factors augmenting the activity up to a certain limit.“”

If, accordingly, we compare the ordinary state with the state of attention, we find in the former weak representations, and but few movements; but in the latter, a vivid representation, energetic, and convergent movements, and moreover repercussion of the movements produced. It matters little, whether this last addition be conscious or not : consciousness does not perform the operation; it simply profits by it.

It may perhaps be interposed. that, admitting this reaction of the movements upon the brain, still there is nothing to prove that the movements are originally the simple effect of attention. There are three hypotheses possible, namely: either, attention (the state of consciousness) is the cause of the movements, or it is the effect of the same, or it is first the cause and afterwards the effect of the movements.

Still, I do not wish to choose between these three hypotheses which have a purely logical and dialectic import, but rather to put the question otherwise. In the above-stated form the problem is thoroughly impregnated-without appearing to be so-with that traditional dualism, of which psychology finds it so difficult to rid itself; and the problem is reduced, in effect, to the question, whether in attention the soul first acts upon the body or the body upon the soul. This enigma is not for me to solve. To the eye of physiological psychologythere exist only internal states, differing among each other as well by their peculiar qualities

* Loc. cit., p. 316.

as by their physical concomitants. If the intellectual state produced is weak, brief, without perceptible expression, then it is not attention. If it is strong, stable, well-defined, and marked by the before-mentioned physical modifications, then it is attention. The point here maintained is, that attention does not exist in *abstracto*, as a purely inward event : it is a concrete state, a psycho-physiological complex. Take our spectator at the opera. Abstract from him the adaptation of eyes, head, body, limbs, changes of respiration and cerebral circulation, etc., and the conscious or unconscious reaction of all these phenomena upon the brain; and that which is left of the original whole, thus despoiled and emptied, is no longer attention. If anything remain, it is an ephemeral state of consciousness, the shadow of that which has been. We hope that this example, however far-fetched it may seem, will better contribute to an understanding of this point than long disquisitions. The motory manifestations are neither effects nor causes, but elements ; together with the state of consciousness, which constitutes their subjective side, *they are* attention.

The reader, however, is not to regard this as anything more than a rough outline, or provisional view, that will be completed later on. Thus, we have not spoken of the feeling of effort, because it is very rare in spontaneous attention, if met with at all. But the part sustained by the movements is sufficiently important to justify repeated investigations of the subject.

III.

THE state of surprise or astonishment is spontaneous attention augmented ; a few words with reference to it are now in order. Although of frequent occurence in

every-day life, it has been forgotten by psychology. I find, however, in the *Traité des* of Descartes (Part II, Art. 70) the following definition : " Admiration is a sudden surprise of the soul, which causes it to consider with attention those objects that to it appear unfrequent and extraordinary. Thus, in the first place, it is caused by the impression in our brain representing the object as rare, and consequently as worthy of exceptional consideration.; and in the second place by the movement of our thoughts, which by virtue of that impression are disposed to tend with great force toward the locality of the brain in which the impression rests, in order to strengthen and preserve it there ; as they are also disposed, through that impression, to pass from thence into the muscles that serve to maintain the sensory organs in the same position in which they are, in order that, if originally formed by the organs of sense, the impression may be further prolonged by their support. " It will repay us, well to ponder this passage. If we carefully peruse it, we shall find that due allowance being made for slight differences of language, nearly all the elements which we have endeavored to point out in the mechanism of spontaneous attention, are therein clearly enumerated ; namely :--the augmentation of nervous influx in consequence of the impression ; its partial conduction toward the muscles; the action of these muscles in order "to support " and " to strengthen. " Incidentally we may remark, that Descartes's method of treatment is that of physiological psychology and not that of spiritualistic psychology, which quite improperly lays claim to him.

Surprise, and in a higher degree astonishment, is a shock produced by that which is new and unexpected ; as if, for example, a person who travels little and whom

I believe to be at home, some five or six' hundred miles away, suddenly enters my room.

From the mental standpoint, there is little to be said of it. It belongs to the group of Emotions, and in its strong form, it is a commotion. Properly speaking, it is not so much a state, as an intermkdiate condition between two states, an abrupt rupture, a gap, an hiatus. At the moment of the shock the previous polyideism abruptly ends, because the new state rushes in, like a giant, into the struggle for life going on among the states of consciousness. By degrees the new state finds its place, is put into connection with others, and equilibrium tends to be re-established ; but surprise having passed away, the state that follows it is attention, that is, an adjusted monoideism—adaptation having had time to take place. The intellectual element regains the upper hand over the emotional element. It is highly probable, that in the state of surprise we have imperfect knowledge because we have too much sensation.

From the physical side the symptoms are an exaggeration of spontaneous attention. "Attention," as we have seen, "is shown by the eyebrows being slightly raised; and as this state increases into surprise, they are raised to a much greater extent, with the eyes and mouth widely open. . . . . The degree to which the eyes and mouth are opened corresponds with the degree of surprise felt. "* This raising of the eye-brows is an instinctive act ; because it is also met with in individuals born blind : it allows the eyes to be opened very rapidly. As to the opening of the

* Darwin 'The Expression of the Emotions' (Chap. XII). The probable origin of these diverse movements is discussed there.

mouth, it permits a vigorous and deep inspiration, which we are always wont to make before any great effort.

We have said, that surprise is spontaneous attention augmented. I believe that this assertion is perfectly allowable. This state best exemplifies the emotional causes of spontaneous attention; for, from the latter there is an insensible gradation to surprise, to astonishment, to stupefaction, and finally to fright and to terror, which are emotional states of a very high degree of intensity.

Brought back now to the point from which we started, we are thus able to see, that the origin of attention is very humble, and that its primitive forms have actually been bound up with the most exacting conditions of animal life. Attention, from the first, had but a biological value. The habit of psychologists to restrict themselves to voluntary attention and even then to its higher manifestations, concealed its origin.

We may assert "apriori" that if attention is caused by emotional states, which in their turn are caused by tendencies, needs, and appetites, it is in its last 'analysis inseparably bound up with that which lies deepest in the individual-the instinct of self-preservation.

A rapid examination of the facts will enable us better to see that the power of being attentive in the struggle for life has been an advantage of the foremost order; but we must leave man and descend lower still—indeed, very low-in the scale of animal life. I leave aside completely the rudimentary forms of psychic life, which only too easily afford a pretext for conjectures and aberrations. In order that attention can be evoked, a few developed senses at least will be requisite, a few clear perceptions, and a competent motor apparatus. Riccardi, in his previously mentioned

work, finds the first clear expression of attention in *Arthropoda.*

Any animal so organized that the impressions of the external world were all of equal significance to it, in whose consciousness all impressions stood upon the same level, without any single one predominating or inducing an appropriate motory adaptation—were exceedingly ill-equipped for its own preservation. I shall overlook the extreme case, in which predominance and adaptation would favor detrimental impressions; for an animal thus constituted must perish, being an illogical organism-a kind of incorporate contradiction. The usual case remains, viz. : the predominance of useful sensations, that is, of those connected with nutrition, self-defence, and the propagation of the species. The impressions of prey to be caught, of an enemy to be avoided, and from time to time, of a female to be fecundated, become settled in the consciousness of the animal with their adapted movements. Attention, thus, is at the service of and dependent upon necessities; always connected with the sense. most perfectly developed, the sense of touch, of sight, of hearing, of smelling, according to the species. Here attention is seen in all its simplicity, and here it affords the most instruction. It was necessary to descend to these rudimentary forms, in order to grasp the reason of its power :-attention is a condition of life ; and it will preserve this identical character in its higher forms, where, ceasing to be a factor of adaptation in a purely physical environment it becomes, as we shall see, a factor of adaptation in the social environment. In all the forms of attention, from the lowest to the highest, there is *unity of composition.*

And besides, among the highest-class animals even,

attention loses its limited and material character. The great majority of animal species are enclosed within the narrow circle of feeding, propagating, sleeping; in this their entire activity is expended. The most intelligent have a superfluous activity, which is expended in the form of play-a manifestation which is so important, that several authors have made play the original source of art. To this need of luxury there also corresponds an attention for luxury. Dogs, that their masters amuse in a certain manner, become attentive when they see the latter making preparations for the same game; and a close observer of children, Sikorski, has shown that their activity and attention are mainly developed through play.*

* *Revue Philosophique*, April, 1885.