CHAPTER II.

VOLUNTARY ATTENTION.

VOLUNTARY or artificial attention is a product of art, of education, of direction, and of training. It is grafted, as it were, upon spontaneous or natural attention, and finds in the latter its conditions of existence, as the graft does in the stock, into which it has been inserted. In spontaneous attention the object acts by its intrinsic power ; in voluntary attention the subject acts through extrinsic, that is, through superadded powers. In voluntary attention the aim is no longer set by hazard or circumstances; it is willed, chosen, accepted or, at least, submitted to ; it is mainly a question of adapting ourselves to it, and of finding the proper means for maintaining the state ; and hence voluntary attention is always accompanied by a certain feeling of effort. The maximum of spontaneous attention and the maximum of voluntary attention are totally antithetic ; the one running in the direction of the strongest attraction, the other in the direction of the greatest resistance. They constitute the two polar limits between which all possible degrees are found, with a definite point at which, in theory at least, the two forms meet.

Although voluntary attention is almost the only form that psychologists have studied, and though to the majority it constitutes all of attention, its mechan-

ism, nevertheless, has not been any better understood. In attempting to arrive at some comprehension of it, we first propose to investigate how voluntary attention is formed, to inquire into its genesis; then we shall study the feeling of effort by which it is accompanied, and finally the phenomena of arrested motion or inhibition, which, in our opinion, play a principal part in the mechanism. of attention.

I.

The process through which voluntary attention is formed, may be reduced to the following single formula: To render attractive, by artifice, what is not so by nature; to give an artificial interest to things that have not a natural interest. I use the word ((interest " in the ordinary sense, as equivalent to the periphrase : anything that keeps the mind on the alert. But the mind is only kept alert by the agreeable, disagreeable, or mixed action of objects upon it, that is, by emotional States. With this difference however, that here the feelings that sustain attention, are acquired, superadded, not spontaneous, as in its primitive manifestations. The whole question, accordingly, is reduced to the finding of effective motives; if the latter be wanting, voluntary attention does not appear.

Such is the process in general ; in practice, however, it becomes infinitely diversified.

In order properly to understand the genesis of voluntary attention, the best way will be to study children and the higher animals. The simplest examples will prove the most instructive.

During the earliest period of its life the child is

only capable of spontaneous attention. It fixes its gaze only upon shining objects, and upon the faces of its mother or nurse. Toward the end of the third month it explores its field of vision, by degrees allowing its eyes to rest upon objects less and less interesting (Preyer). The same takes place in regard to the other senses ; there is a slow transition from that which is of greatest concern to that which is of least concern. The fixing of the gaze, which later becomes intense attention, is outwardly expressed by the more marked contraction of various muscles. Attention in the infant isaccompanied by a certain emotional state, which Preyer calls "the emotion of astonishment." At its highest point, this state produces a temporary immobility of the muscles. According to Dr. Sikorski, "astonishment, or rather. the emotion that accompanies the psychic process of attention, is chiefly characterized by the momentary suspension of respiration-a striking phenomenon indeed, after being accustomed to the rapid respiration of children."* It is almost impossible to tell, at what period the first appearance of will takes place. Preyer claims to have noticed indications of will toward the fifth month, but in its impulsive, form ; as a power of inhibition it appears much later.

So long as the psychic life thus remains in the tentative epoch, attention, that is, the transfer of the mind from one object to another, is determined only by the objects' power of attraction. The birth of voluntary attention, the power of fastening the mind upon non-attractive objects, can only be accomplished by force, under the influence of education, whether de-

* Sikorski : "*Le Développement psychique de l'Enfant.* (*Revue Philosophique*, April, 1885.)

rived from men or things external. Education, derived from men, is, of course, the most easily demonstrable, but it is not the only kind.

A child refuses to learn how to read ; it is incapable of keeping its mind fixed upon letters that have no attraction for it; but it will gaze with eagerness upon pictures in a book. "What do those pictures mean ? " Its father answers : "When you know how to read, the book will tell you." After a few talks of this kind the child finally gives up ; at first it sets about the task lazily, but afterwards it becomes accustomed to its work, and finally evinces an eagerness that needs to be checked. In this we have an instance of the genesis of voluntary attention. It was necessary to graft upon a desire natural and direct, a desire artificial and. indirect. Reading is an operation that does not possess an immediate attraction, but as a. means to an end it has an attraction-a kind of borrowed attraction—and that is sufficient : the child has been caught in a wheel-work, as it were, and the first step has been accomplished. The following is another example from B. Perez.* "A child six years old, habitually very *inattentive*, went to the piano one day, of its own accord, to repeat an air that pleased its mother; and it remained there for over an hour. The same child, at the age of seven, seeing its brother engaged about some of his holiday-duties, entered and seated itself in its father's study. 'What are you doing ?' asked the nurse, astonished at finding the child there. 'I am doing a page of German ; it is not very amusing ; but I wish to give Mamma a pleasant surprise.' " Here we have another case of the genesis of voluntary attention, this time grafted upon a sympathetic, and not

* B. **Perez** : *L'Enfant de trois à sept ans*, p. 108.

upon a purely selfish feeling as in the former example. The piano and the German lesson did not spontaneously evoke attention ; they awaken and maintain it through the medium of a borrowed force.

In every instance of the origination of voluntary attention this mechanism is invariably found to be the same,-but in endless variations, resulting in success, half-success, or failure : ever grasping natural motives, diverting them from their direct purpose, using them, if possible, as means for another end. Art bends nature to its purposes, and for this reason I call this form of attention, artificial.

Without assuming to enumerate all the different motives that artifice puts into play, in order to call forth and to consolidate voluntary attention, that is,-to repeat once more my former statement,-in order to impart to the purpose in view a power of action that it naturally does not possess, I shall now indicate three periods in point of time into which voluntary attention falls.

In the first period, the educator acts only upon simple feelings. He employs fear in all its forms, egotistic tendencies, the attraction of rewards, tender and sympathetic emotions, as well as our innate curiosity, which seems to be the appetite of intelligence, and which to a certain degree-no matter how weak—is found in everybody.

During the second period, artificial attention is aroused and maintained by means of feelings of secondary formation, such as love of self, emulation, ambition, interest in a practical Iine, duty, etc.

The third period is that of organization; attention is aroused and sustained by habit. The pupil in the class-room, the workman in his shop, the clerk at his

office, the tradesman behind his counter, all would, as a rule, prefer to be somewhere else ; but egotism, ambition, and interest have created by repetition a fixed and lasting habit. Acquired attention has thus become a second nature, and the artificial process is complete. The mere fact. of being placed in a certain attitude, amidst certain surroundings, brings with it all the rest; attention is produced and sustained less through present causes than through an accumulation of prior causes; habitual motives having acquired the force of natural motives. Individuals refractory to education and discipline, never attain to this third period; in such people voluntary attention is seldom produced, or only intermittently, and cannot become a habit.

It is unnecessary to show in detail that also in animals the transition from spontaneous attention to voluntary attention is similarly effected under the influence of education, and of training ; but here the educator only has at his disposal limited means of action, very simple in character. He acts upon the animal through fear, privation of food, violence, kindness, caresses, and in this manner he succeeds in making the animal contract certain habits, and through artifice become attentive. Among animals, as among men, there are teachable and refractory individuals. "A man," says Darwin,"* "who trains monkeys to act in plays, used to purchase common kinds from the Zoological Society, at the price of £5 for each ; but he offered to give double the price, if he might keep three or four of them for a few days in order to select one. When asked how he could possibly learn so soon whether a particular monkey would turn out a good actor, he answered that it all depended on their

* "Descent of Man," Vol. I

power of attention. If, when he was talking and explaining anything to a monkey its attention was easily distracted, as by a fly on the wall, or other trifling object, the case was hopeless. If he tried by punishment to make an inattentive monkey act, it turned sulky. On the other hand, a monkey which carefully attended to him could always be trained."

Accordingly, at the root of attention we find only emotional states, attractive or repulsive tendencies. In the spontaneous form these are the only causes. In the voluntary form, it is the same ; yet with this difference, that here the feelings are of a nature more complex and of slow formation, derived through experience from primitive tendencies. If, while voluntary attention is still in its period of genesis, before it has been organized and fixed by habit, you take away from the school-boy all love of self, all emulation, all fear of punishment, leave a fortune to the tradesman or the workman, grant a competence to the clerk from the very outset of his career, all their attention to their distasteful employments will at once be scattered to the wind, for there is nothing left to evoke and sustain it. I confess that this genesis of attention is very intricate; but it is conformable to facts. According to most psychologists it would seem, that voluntary -attention-which, although only a derivative and acquired form, is yet the only one that they regal-d-enters without an antecedent foundation. "Voluntary attention is subject to the superior authority of the Ego. I give or withdraw it, as I please ; by alternate turns I direct it toward different points. I concentrate it upon each point, as long as my will can sustain its effort."* If this be not a purely

* Dirt. *scient. phil.*, 2e *édit.*, *Art.* "*Attention.*"

conventional and fanciful description, if the author derives it from his own personal. experience, I should not withhold niy genuine admiration. But in truth, we should be destitute of all 'genius of observation, or blinded by prejudice, if we did not perceive that voluntary attention, in its durable form, is really a difficult state to sustain, and that actually many do not attain to it.

But if, as we have attempted to show, the higher form of attention is the work of the education that we have received from our parents, teachers,and surroundings, as well as the education which later we have ourselves acquired in imitating that which we earlier experienced, this explanation, nevertheless, only forces the difficulty further back ; for our teachers have only acted upon us, as others had previously acted upon them, and so on back through the generations. This, accordingly, does not explain the primordial genesis of voluntary attention.

How then does voluntary attention originate? It originates of necessity, under the pressure of need, and with the progress of intelligence. *It is an instrument that has been perfected—a product of civilization.* The same progressive movement that in the order of moral events has caused the individual to pass from the control of instincts to that of interest and duty; in the social order, from primitive savagery to the state of organization; in the political order, from almost absolute individualism to the constitution of a government : this same onward movement, in the intellectual world, has also effected the transition from spontaneous attention to the dominance of voluntary attention. The latter is both effect and cause of civilization.

In the preceding chapter it was pointed out that,

in the state of nature the power of spontaneous attention, both for animals and men, is a factor of the foremost order in the struggle for life. In the course of man's development from the savage state, so soon as (through whatever actual causes, such as lack of game, density of population, sterility of soil, or more warlike neighboring tribes) there was only left the alternative of perishing or of accommodating oneself to more complex conditions of life,-in other words, to go to work,—voluntary attention also became a foremost factor in this new form of the struggle for existence. So soon as man had become capable of devoting himself to any task that possessed no immediate attraction, but accepted as only means of livelihood, voluntary attention put in an appearance in the world. It originated, accordingly, under the pressure of necessity, and of the education imparted by things external.

It is easily shown that before civilization voluntary attention did not exist, or appeared only by flashes and then of short duration. The laziness of savages is well-known ; travelers and ethnologists are all agreed on this point, and the proofs and instances are so numerous that it would be idle to quote authorities. The savage has a passion for hunting, war, and gambling; for the unforeseen, the unknown, and the hazardous in all its forms ; but sustained effort he ignores or contemns. Love of work is a sentiment of purely secondary formation, that goes hand in hand with civilization. And we may note, now, that work is the concrete, the most manifest form of attention.

Continuous work is repugnant even to half-civilized tribes. Darwin asked certain Gauchos who were addicted to drink , gambling, and theft, why they did not work. One of them answered : ''The days are

too long." * "The life of the primitive man," says Herbert Spencer,† "is passed mainly in the pursuit of beasts, birds, and fish, which yields him a gratifying excitement; but though to the civilized man the chase gives gratification, this is neither so persistent nor so general. . . . . Conversely, the power of continued application, which in the primitive man is very small, has among ourselves become considerable. It is true that most are coerced into industry by necessity, but there are sprinkled throughout society men to whom active occupation is a need-men who are restless when away from business and miserable when they eventually give it up ; men to whom this or that line of investigation is so attractive that they devote themselves to it day after day, year after year, hardly giving themselves the rest necessary for health."

But, as in order to live at all, even as savages, it is necessary from time to time to perform some kind of drudgery, such labor, as is well known, usually devolves upon women, who, while their husbands sleep, work from fear of being beaten. It is accordingly possible-although at first it may seem a paradox-that voluntary attention first originated in woman.

Even among nations enjoying the advantages of long centuries of civilization, there exists a complete class of beings that are incapable of protracted work, -vagabonds, professional thieves, and prostitutes. The Italian criminologists of the new school, whether rightly or wrongly, look upon these as cases of atavism. The majority of civilized nations, however, have sufficiently adapted themselves to the exigencies of social life ; and they all are to a certain degree capable of

* *Voyage d'un Naturaliste au Tour du Globe*, p. 167.
† "Data of Ethics," Chap. X.

voluntary attention. But the number of those, of whom Spencer speaks, to whom voluntary attention is an urgent necessity-is very small indeed; and few and far between are those who profess and practice the *stantem oportet mori*. Voluntary attention is a sociological phenomenon. When we consider it as such, we shall better understand both its genesis and its infirmity.

The fact, we may say, has now been established, that voluntary attention is an adaptation to the conditions of a higher social life ; that it is a discipline and a habit, an imitation of natural attention, which latter serves, at the same time, as its point of departure and point of support.

II.

Up to this point we have only examined, in our investigation of the mechanism of attention, the external impulsion arising from stimuli and surroundings which causes it to pass from one form to an other. We now come upon a much more obscure question, namely, the study of the internal mechanism through which a state of consciousness is laboriously maintained, in the face of the psychological struggle for life which incessantly tends to make it disappear. The relative monoideism we have had to deal with, which consists in the preponderance of a certain number of internal states, adjusted towards the same purpose and excluding all others, needs, in the case of spontaneous attention, no explanation. There a state (or a group of states) predominates in the consciousness, because it happens to be by far the stronger ; and it is by far the

stronger, because, as we have seen, all the tendencies of the individual conspire in its favor. The very contrary happens in the case of voluntary attention, especially in its highest artificial forms. What, accordingly, is the mechanism by which this state is maintained ?

It is not requisite to investigate how the state of voluntary attention is producedin daily life. Like every other state of consciousness, it arises at the bidding of circumstances. But the feature that distinguishes 'it from other states, is, that it is prolonged and maintained. If a school-boy with but little taste for mathematics, recollects that he has a certain problem to solve, this is a simple state of consciousness; but if he sets about the task and persists, it is a state of voluntary attention. In order to leave no ambiguity concerning this point, I repeat that the whole problem consists in this very power of inhibition, of retention.

But how can we produce an arrested condition of this sort, an inhibition ? We enter, with this query, upon a question but little known in physiology, and almost unexplored in psychology. Experience constantly proves, that in many cases we have the power to inhibit the movements of various parts of our body. But how is the equivalent of this inhibition produced in the mental order of things ? If the physiological mechanism of inhibition were better known, we should probably be able to answer with more clearness. We accordingly ask the reader to regard the following remarks as an attempt replete with faults and omissions.

The fundamental property of the nervous system consists in the transformation of a primitive excitation into a movement. This is reflex action, the type of nervous activity. But we also know, that certain

excitations may impede, slacken, or suppress a movement. The best known, and oldest-studied, case is that of the suspension of the movements of the heart through irritation of the pneumogastric nerve. Since the discovery of this fact, made by the brothers Weber in 1845, physiologists have devoted much attention to the study of cases in which the excitation of a nerve prevents a movement or a secretion. Pflüger has shown, that the splanchnic nerve has an inhibitory action upon the small intestine. Since that date it has moreover been established, that the movements of the stomadh and of the entire intestinal canal are similarly subject to inhibition. Cl. Bernard has referred to the same cause the action of the vaso-dilator nerves. Finally, this power of inhibition belongs not only to the marrow and to the bulb ; it also exists in the brain. Setschenof at first maintained that the central brain (*optic thalamus*) exerts an inhibitory influence upon the lower parts of the cerebra-spinal axis. Many authors in recent times have referred the phenomena of hypnotism to a cortical inhibition. Fin ally, according to Brown-Séquard, "inhibition is a power possessed by almost all parts of the central nervous system and a considerable portion of the peripheral nervous system. "

To explain this " negative reflex," different theories have been invented, which it would be useless to set forth here.* Let us note, however, that in his " Functions of the Brain," Ferrier was the first who referred attention to an action of the moderatory centres which he places in the frontal lobes. The recol-

* For the history of this problem down to the year 1879, see Hermann, *Handbuch der Physiologie*, Vol. II, part. II, p. 33, et seqq. For the more recent theories, S. Lourie, *I fatti e le teorie dell'inibizione*, in 8vo. Milano, 1888

lection of an idea, he says, depends on the motor element that enters into its composition. Attention depends on the restriction of the movement : there is repression of the external diffusion, and augmentation of the internal diffusion. The excitation of the motor centres, protected against external diffusion, expends its force internally ; repressed excitation of a motor centre occurs. Ferrier's reasons for localizing the moderatory centres in the frontal lobes, are as follows: Intelligence is proportionate to the development of attention; and it is also proportionate to the development of the frontal lobes. Irritation of these lobes does not provoke any motory manifestation ; they are, accordingly, directive agencies, and expend their energy in producing changes in the centres of actual motor execution. Removal of them does not induce motor paralysis, but merely mental degeneration, resulting in loss of attention. The frontal lobes are imperfectly developed in idiots, whose power of attention is veky weak. The frontal regions in animals become by degrees weaker, in proportion as the level of intelligence descends. We may add, that injuries to the frontal lobes will greatly lessen and frequently quite destroy the power of control.* The author declares, that "as to the physiological basis of this faculty of control, theoretical views only can be entertained."

Although the theory, that phenomena of inhibition take place in special organs, has become almost classical ; still, in recent times, several authors, basing their assertion upon experimental grounds, have maintained

*For the facts we may refer the reader to our own work, *Maladies de la Volonté*, p. 30, et seqq. Quite recently an American neurologist, Alex. Starr, in 23 cases of lesion of the frontal lobes, found in one-half of his patients the following mental troubles : loss of the faculty of control, change of character, incapacity of fixing attention. "Brain," Jan. 1886, p. 570.

that "motor actions and actions of inhibition have their seat in the same elements."* "Every time a nerve is excited," says M. Beaunis, "there are produced in the nerve two kinds of modificationsin opposite directions. If it be a motor nerve, there will be set up in the nerve an activity, revealed by a twitching of the muscle ; but beside this phenomenon, which is the most apparent and the one most studied, there is also produced a contrary state, which will tend to impede the shock, or to prevent its appearance. Thus, at *the same* time, in this nerve, there will be motor action and inhibitory action." † The motor process puts in an appearance sooner than the inhibitory process, and lasts a shorter time. The first excitation causes a maximum shock; but with the second excitation the inhibitory action, tending to be produced, diminishes its amplitude. In one of Wundt's experiments, "when a nerve is excited by a constant current, there is produced at the anode an inhibitory wave, which is recognized by the lessened excitability of the nerve, and which is slowly propagated from both sides of the anode : simultaneously, there is produced at the cathode a wave of excitation, that, with still greater swiftness and intensity, is propagated along from both sides of the cathode. An excited nerve, accordingly, is traversed at the same time by a wave of inhibition, and by a wave of excitation, and its excitability is but the algebraic resultant of these two contrary actions."

On this hypothesis, then, every excitation would

* Wundt, *Untersuchungen zur Mechanik der Nerven und Nervencentren*, 1871, 1876, and *Physiologische Psychologie*, Vol. I, Chap. IV. Beaunis, *Recherches expérimentales sur ies conditions de l'activité cérébrale et sur la physiologie du nerf.* Paris, 1884. M. Beaunis has dwelt, more than any other physiologist, upon the importance for psychology of inhibitory actions.

† Op. Cit., p. 97.

determine in the nervous substance two modifications, the one positive and the other negative : a tendency to activity on the one side, and a tendency to the inhibition of this activity on the other side; the final effect is nothing more than the resultant of these contrary actions, so that at one time impulsion and at another stoppage will prevail.

We have now very succinctly set forth nearly all that physiology teaches us concerning the mechanism of inhibition, and we shall have occasion to make use of it. We may revert now to the psychological phase of the problem.

The power of voluntary inhibition, whatever may be its *modus operandi*, is a secondary formation. It appears relatively late, as do all manifestations of a higher order. Volition in its positive, impulsive form—the volition which accomplishes something-is the first in order of time. Volition in its negative form, which hinders something, appears later ; according to Preyer,* toward the tenth month, in the very humble form of inhibition of natural evacuations.

But how is inhibition accomplished? This question cannot be answered satisfactorily. However, let us observe, that in this regard our position is exactlythe same as when we are confronted with the opposite question : How do we produce a movement? In positive volition, the " I will" is usually followed by a movement ; that is to say, there is a setting into activity, in the brain, of motory images or appropriate motory residua; a transmission of the nervous influx through the corona radiata to the corpora striata, to the inferior stratum of the cerebral peduncle, to the bulb, and then after decussation to the spinal marrow,

* " The Soul of the Child."

to the nerves,and finally to the muscles. In negative volition, the "I will" is usually followed by an inhibition. Here the anatomical and physiological conditions of the transmission are less accurately known ; upon the previously expounded hypothesis they would not be different from the preceding case. But in both cases consciousness directly knows only two things : the fact of departure, and the fact of arrival ; the "I will" and the act produced or inhibited. All the intermediate states escape it, and consciousness only knows them through knowledge acquired, and indirectly. Thus situated as regards the sum of our present knowledge, we must limit ourselves to stating, as a matter of fact, that just as we possess the power of beginning, continuing, and increasing a movement, we also are able to suppress, to interrupt, and to diminish any movement.

These general considerations bring us, at least, to one positive result ; namely, that every act of volition, whether impulsive or inhibitory, "*acts* only upon muscles and *through muscles*" ; that any other conception is vague, incomprehensible, and chimerical; that consequently, if, as we maintain, the mechanism of attention is motory, then in all cases of attention there must necessarily be a play of muscular elements, real or nascent movements, upon which the power of inhibition acts. We exercise no action (impellent or inhibitory) upon any other than voluntary muscles ; such is our only and positive conception of will. Of two things, accordingly, one at least must be hit upon : either to find muscular elements in all manifestations of voluntary attention, or else to abandon all explanation of its mechanism, and to limit ourselves to saying that it exists.

Attention voluntarily addresses itself to perceptions, images, and ideals; or to speak more precisely, and to avoid all metaphor, the state of monoideism can be voluntarily maintained by a group of perceptions, images, or ideas, adapted to a purpose fixed upon in advance. In these three cases we have to determine the motor elements that are met with.

1. As regards perceptions, there are no difficulties. All our organs of perception are at the same time sensorial and motor. To perceive with our eyes, ears, hands, feet, tongue, nostrils, movements are needed. The more mobile the parts of our body, the more exquisite is their sensibility ; the less perfect their motile power, the more obtuse their sensibility. Nor is this all ; without motor elements, perception is impossible. We will call to mind a previous statement that if the eye be kept fixed upon a given object without moving, perception after a while grows dim, and then disappears. Rest the tips of the fingers upon a table without pressing, and the contact at the end of a few minutes will no longer be felt. But a motion of the eye, or of the finger, be it ever so light, will re-arouse perception. Consciousness is only possible through change : change is not possible save through movement. It would be easy to expatiate at great length upon this subject; for although the facts are very manifest and of common experience, psychology has nevertheless so neglected the role sustained by movements, that it actually forgot at last that they are the fundamental condition of cognition in that they are the instrument of the fundamental law of consciousness, which is relativity, change. Enough has now been said to warrant the unconditional statement, that where there is no movement there is no perception.

The rôle of movement in sensorial attention is not subject to the slightest doubt. The watchmaker who is minutely studying the wheel-work of a watch, adapts his eyes, hands, and body; all other movements are suppressed. In laboratory experiments, instituted to study voluntary attention, this state of concentration through inhibition of movements, frequently attains an extraordinary height; we shall speak of it further on. But we may refer again to Galton's observations, reported in the preceding chapter, upon movements produced in a fatigued audience.

Attention, accordingly, means concentration and inhibition of movements. Distraction means diffusion of movements.

Voluntary attention, thus, may also act upon the expression of emotions ; as where we have strong motives for not outwardly betraying a feeling and possess a power of inhibition capable of preventing such expression. But it only acts upon muscles-upon muscles alone. Everything else escapes. its control.

So far we have treated the problem from the point easiest of approach. We now come to that purely internal form, called "*reflexion.*" Images and ideas constitute its subject matter. In these two groups of psychic states, accordingly, we must now find the motory elements.

2. "It does not seem plain, at first," wrote Bain, as early as the year **1855,** "that the retention of an idea, an image, in the mind is the work of our voluntary muscles. What are the movements produced, when I conceive to myself a circle, or think of St. Paul's? We can answer this question only by supposing that the mental image occupies in the brain and the other parts of the nervous system the same

place as the original sensation. As there is amuscular element in our sensations, particularly in those of the highest, order-in touch, sight, and hearing-this element must, in some way or other, find its place in ideal sensation-in recollection." Since the time that this passage was written, the question of the nature of images has been closely and profitably studied, and solved exactly as therein indicated.* Whereas: to the earlier psychologists, an image or idea was a kind of phantom, without definite seat, existing "within the soul," differing from perception not in degree but in nature, resembling it "at most only as a portrait resembles its original;" to physiological psychology, on the contrary, there is between perception and image identity of nature, identity of seat, and only a difference of degree. The image is not a photograph but a revival of the sensorial and motory elements that have built up the perception. In proportion as its intensity increases, it approaches more and more to the condition of its origination, and so tends to become an hallucination.

Keeping closely to the motor elements of images (being the only ones that interest us), it is clear, that since there is no perception without movements, the latter, after they have been produced, leave behind in the brain motory residua (motory images, motory intuitions), exactly as the impressions upon the retina or skin leave behind sensorial impressions. If the motory apparatus did not possess a memory of its own, images, or residua, no movement could be learned and made habitual. Everything would always have

* Consult Taine, *De l'Intelligence*, Vol. II; Galton, "Inquiry into Human Faculty," etc., pp. 83–114; Charcot, *Leçons sur les maladies du système nerveux*, Vol. III; Binet, *Psychologie du raisonnement*, Chap. II; Ballet, *Le Langage intérieur et les diverses formes de l'aphasie*.

to begin over again. However, it is not necessary to fortify this by argument. Innumerable experiments prove that movement is inherent in the image and contained in it. Chevreul's famous experiment with the pendulum may be regarded as typical. Is it necessary to cite more ? how there are people who plunge head foremost into yawning chasms, through fear of falling into them ? people who cut themselves with razors, through the very fear of cutting themselves? or the case of "thought-reading," which is but a reading of muscular states? and so many other facts that are reputed extraordinary simply because people are ignorant of the elementary psychological fact, that every image contains a tendency towards motion? Of course, the motor element does not always possess these enormous proportions, but it exists at least in a nascent state; just as the sensorial image does not always possess hallucinatory vividness, but exists simply in outline in the consciousness.

3. If it is easy enough to establish the existence of motor elements in images, the question of general ideas or concepts, on the other hand, is more difficult. Physiological psychology, it must be acknowledged, has greatly neglected ideology, and the latter study is in great need of revision from the standpoint of acquired experimental data. The study of perceptions and images has paved the way for this task. But it is not my intention to treat incidentally so great a question. My purpose merely is, as a means of finding our true bearings, to group general ideas into the following three great categories :

a) Those which result from the fusion of "similar" images, without the aid of words;

b) Those which result from the fusion of "dissimilar" images, with the aid of words;

c) Those which are reduced to words, to language, accompanied with a vaguely represented outline, or even without any concomitant representation whatsoever.

I shall disregard the regulative concepts (those of time, space, and cause), the investigation of which would carry us too far from our path. And we may now examine, whether each of these three categories includes motor elements, upon which attention may act.

a) The first category comprises general ideas of the rudest sort, those which are met with in higher animals, children, and deaf-mutes, before the use of analytical language. The operation of the mind is limited to grasping very striking resemblances, and so to framing *generic images*— a term that really would be more correct than general ideas. The operation in question seemsclosely analogous to the process by which Galton, through superposing several photographs, obtains the composite portrait of a family, or an accumulation of resemblances with elimination of minor differences. But to maintain, as it has been maintained, that this process explains the formation of general ideas, is an untenable position. It explains only the very lowest grades; being an operation that can deal only with gross resemblances. Now, do these generic images include a motor element? It is very difficult to say, and, in any case, it is to no purpose; for it is not at this stadium of mental life that voluntary reflection enters.

6) The second category comprises the majority of the general ideas that serve the current purposes of thought. In a more complete study of the present

subject, we would have occasion to establish an ascending gradation of groups, rising from the less general to the more general-a gradation indicating the power of discerning ever fainter resemblances and fewer and fewer analogies. All the degrees of this ascending progression are met with in the history of humanity. Thus it is that the Fuegians possess no abstract terms. The American Indians have words to designate the white oak, and the black oak; but they have no word for oak in general. The Tasmanians have a term for each species of trees, but none for tree in general ; and more naturally so, none for plant, animal, color, etc.* Not to dwell upon these different phases however, what is there in our mind when me think these general ideas ? In the first place, a word, which is the fixed element ; along with it an image, less and less complex, less and less clear, in proportion as we ascend in generalization. This image is an " extract," an *ab*stract. It is formed by a process that the mind employs even to represent to itself an *individual* image. Thus, it is observed, that the representation I have of Peter, of Paul, of my dog, or of any concrete being or object well known to me, can only be an extract, an abstract, of the multiple perceptions that I have already had of it and which have revealed the object to me under its different aspects. In the representation of an individual image there is a struggle among the former images of the same object for supremacy in consciousness. In the conception of a general idea, there is also a struggle among different generic images, for supremacy in consciousness. An abstract of the second or third degree is produced.

*Lubbock, "The Origin of Civilization," Cb. IX. Taylor, " Primitive Culture," Vol. I, Ch. VII.

There is thus formed a common nucleus, around which oscillate vague and obscure elements. My general conception of man or dog, if it persist ever so short a time in consciousness, tends to take a concrete form ; it becomes a white man or a black man, a spaniel or a bulldog. The motor element is especially represented by the word; we shall revert to this subject again. As to the images or abstracts of images annexed to the word, it would be difficult to tell what remains in them of the movements included in the original perceptions.

c) In the preceding category, in proportion as ideas grow more general, the part played by images gradually vanishes, the word more and more preponderates, up to the moment when it alone remains. We have, accordingly, the following progression, *viz.* : generic images without words, generic images with words, words without images. At this last stage we find purely scientific concepts. But, does the word exist alone in the mind at this supreme point of abstraction ? I maintain, unhesitatingly, that it does. I cannot enter into details, which would carry me too far from my subject. I shall limit myself to observing, that if in fact there is nothing beneath the word, 'there is, there must be, a potential knowledge, the possibility of a cognition. " In actual thought," says Leibnitz, "we are accustomed to neglect the explanation of signs through that which they signify, knowing or believing that we have this explanation at our command ; in fact, we do not deem this application or explication of the words to be actually necessary. This method of reasoning I designate blind or symbolical. We employ it in algebra, in arithmetic, in fact, universally." Learning how to count in the case of chil

dren, and, better still, in the case of savages, clearly shows, how the word, at first firmly clinging to objects, then to images, progressively detaches itself from them, to live an independent life of its own. Finally, the word much resembles paper-money (bank-notes, cheques, etc.), having the same usefulness and the same dangers. In the instance we are now considering, the motor element can be found only in the word. Recent researches, to which we have already referred, show that words do not exist in the same form in all individuals. To some it consists chiefly in articulative conditions. Stricker, in his book upon "Word and Music," has described from his own experience a perfect type of this : such are emphatically motory in nature. To others, words mainly consist in auditory images ; this is the *inward* **word,** as it has been admirably described by V. Egger. Still others, far less frequently met with, think by the help of words or *written.** The latter are visual.

Now, in the majority of men, these different elements act in unequal proportions. But everywhere and always, the word pronounced aloud, the purely internal sign, rests upon some, original form of perception, and consequently contains motor elements. It is unquestionably true, that the motor elements contained in general ideas of whatever category, are often very weak. This accords, moreover, with the fact of daily experience, that abstract reflection is impossible to many persons, and difficult and fatiguing to almost everybody.

We have dwelt at length upon this division of our

*There has been published a curious instance of the latter in the *Revue Philosophique*, January, 1885, p. 119. Also see Ballet, in the work cited above, Chap. III.

subject, because it is the least investigated, the most difficult, and most exposed to criticism.* But the reader will say: "We admit that there are motor elements in perceptions, images, and, to a less degree, in concepts. Still, that does not establish the fact, that attention acts upon them, and through them; and that it is a motory mechanism." True, upon this point we can cite no observation or experiment that would be decisive. The crucial test would consist in

*The study of a large number of normal and morbid cases has led to the knowledge of several types: motory, auditory, and visual, according to the group of images predominating in each individual; not to mention the ordinary or indifferent type. The person who thinks his words by articulating them, without hearing them (Stricker) and the person who thinks his words by hearing them, without articulation (V. Egger); the person who thinks his words by seeing them written, without either hearing or articulating them: all these represent irreducible types. This precludes all discussion. Each person is right, in so far as he himself, and people like him are concerned; but he will be wrong, if he generalizes without restriction

It is much to be desired, that the work accomplished in the study of images and different forms of language, were likewise attempted for general ideas. It is probable, that here also we should find irreducible types. Thus Berkeley seems to me to think general ideas in the *visual* form. Any one who attentively reads certain passages (too long to transcribe here) of his famous Introduction to his "Treatise on Human Nature," any one who studies it, not as a theory of general ideas, but as an instrument of psychological evidence, a kind of psychological confession, will conclude, that to Berkeley the general idea was a vision. "The idea of man, that I am able to form for myself," says he, "must be that of a white, black, or sunburnt man, straight or bent, tall, small, or of medium size. I am unable by any effort of thought to conceive the abstract idea before described" [namely, of color that is neither red, blue, green, nor etc., and which would still be a color]. On the other hand, the nominalists seem to me to think general ideas under the purely *auditory* form. The famous theory which makes of universals mere "*flatus vocis*," (Roscelin, Hobbes, etc.,) appears, in my opinion, to admit of two interpretations, Taken literally, the theory is nonsense. The pure "*flatus vocis*" is a word in a language wholly unknown-a word not associated with any idea, and consequently a mere sound, a noise. It is hardly probable that sensible thinkers have ever maintained this theory in the form usually attributed to them. Their position, I think, may be explained by the fact, that the nominalists are of a hard, algebraic turn of mind, to whom the word is sufficient, without the awakening of any image in them there is no other representation than that of the sound. We are here very far from Berkeley.

Stricker, who is purely motory in this regard, who is unable to think a word without articulating it, who depends as little upon hearing, as is possible, expresses himself as follows: "I have to attach some sort of an object to every

discovering whether a man, deprived of all external and internal motility-and of that alone-would be still capable of attention. But that experiment is not practicable. Even in the morbid cases that we shall study later on, there is nothing that approaches it. Let us incidentally remark, however, that it is impossible to reflect when running at full speed, even when we run without any other motive than the sake of running; or while climbing up a steep ascent, even where there is no danger and when we are not looking at the landscape. A multitude of instances prove, that there is an antagonism between great expenditure of movement and the state of attention. It is true, people reflect while striding about, and while fiercely gesticulating; yet here the object in view is rather one of invention than of concentration, and excess of nervous force is being discharged through various exits. Definitively, then, it is plain, that attention is an inhibition; and this inhibition cannot be produced save through a physiological mechanism which, in sensorial attention, prevents the expenditure of actual movements, and in reflection, the expenditure of movements in a nascent state : for the production of movement is restitution in the outward direction, a vanishing of the state of con-

word I possess, so that it will not appear to me like a dead term-like a word in a language that is unknown to me. When words occur to my mind such as 'immortality,' 'virtue,' and the like, I usually explain the same to myself not through words, but through visual images. At the word 'virtue,' for example, I think of a female form; at the word 'bravery' of an armed man, etc.," (Op. cit., pp. 80, 81). This conception of abstract and general ideas might be called the antipode of nominalism. In medicine, it is said, that there are no diseases, but only patients ; in the same manner there are no general ideas, but only minds that think them in a different manner. Instead of proceeding philosophically, that is, seeking to reduce everything to unity, it were high time, it seems, to proceed psychologically, that is, to determine the principal types. A great many discussions in this manner would doubtless die a natural death. At all events, this task appears to me worthy of the trouble of being attempted.

sciousness--the nerve-force that produces it having transformed itself into motor impulsion. "Thought," says Setschenof, "is a reflex action reduced to its two first thirds"; or as Bain more elegantly expresses it: "To think is to refrain from speaking or acting."

To conclude, let us see what must be understood by the current expression "voluntarily to direct one's attention to any given object," and what takes place in such a case.

"What is accomplished in such cases," says Maudsley very aptly,* "is the excitation of certain nervous currents of ideas, and their maintenance in action until they have called into consciousness, by radiation of energy, all their related ideas, or as many of them as it may be possible, in the then condition of the brain, to stimulate into action. It would appear, then, that the force that we mean by attention is rather a *vis a fronte* attracting consciousness, than a vis a *tergo* driving it. Consciousness is the result, not the cause, of the excitation. The psychological mode of expression puts the cart before the horse; the problem in reflection is not, as it is said, to *direct* consciousness or to *direct* the attention to an idea, but to *arouse* consciousness of it by stirring it up to a certain pitch of activity."

However, a doubtful point still remains. If we admit that the general mechanism of attention is motory and, in the particular case of voluntary attention, that it chiefly consists of an action of inhibition, we are still induced to ask, how is this inhibition effected, and upon what does it act. This is a question fraught with so much obscurity, that we can do no more than limit ourselves to its simple enunciation;

* "Physiology of Mind," pp. 317, 318, 321

and yet it will be better to attempt an answer, even though purely conjectural, than to appear to elude the difficulty.

It would perhaps not be altogether unprofitable to search for light in an analogous but more simple order of phenomena.

Reflex movements, whether reflex actions proper, natural and innate, or reflex actions that are acquired, secondary, and fixed by repetition and by habit, are produced without volition, hesitation, or effort, and may continue a long time without fatigue. They call into action, in the organism, only those elements necessary to their effectuation, while their adaptation to ends is perfect. In the strictlymotory order of things, they are the equivalent of spontaneous attention, which, similarly, is an intellectual reflex action that presupposes neither choice nor hesitation nor effort, and may likewise continue a long time without fatigue.

But there are other classes of movements that are more complex and artificial ; as, for instance, writing, dancing, fencing, all bodily exercises and all mechanical handicrafts. In these instances, adaptation is no longer natural, but laboriously acquired. It demands the exercise of choice, repeated endeavor, effort, and at the outset is accompanied by fatigue. Daily observation shows, that at first a great number of useless movements are produced : thus a child learning to write, moves arms, eyes, head, and sometimes a part of its body. The end to be sought here is to prevent this diffusion, and by appropriate associations and dissociations to produce the maximum of useful work with the minimum of effort. The reason of the fact observed is, that isolated movements do not exist and that a muscle in contracting acts upon the adjacent

muscles and often upon many others. Success is attained by some lucky hit, after repeated efforts : with apt people quickly ; with awkward persons slowly, or perhaps never at all. The mechanism, however, remains always the same; it consists in firmly strengthening certain movements, in coordinating them into simultaneous groups or into series, and in suppressing, in *inhibiting* all others.

Voiuntary or artificial attention proceeds in the same manner. When one prepares to enter into this laborious state, one sees states of consciousness arising by groups or by series--for isolated states of consciousness no more exist than isolated movements. Among them there are many that do not serve the principal aim, or deviate from it. Here, also, there are useless or detrimental states of consciousness that, if possible, must be suppressed. A considerable portion of our task consists just in this negative work, whereby the intrusive elements are expelled from consciousness, or reduced to their least intensity. But how is this accomplished ? Either we must abandon all explanation, or admit an action of inhibition exerted upon the motor elements of the states of consciousness involved. In such cases we have a very distinct feeling of sustained effort. And whence could that feeling come, if not from the energy expended to accomplish the acts of inhibition ? For, indeed, theordinary course of thought, left to itself, is exempt from any such sensation. If it be objected that from this view-point the fundamental mechanism of voluntary attention remains hidden, it may be replied that indeed the fundamental mechanism of all volition remains hidden. In consciousness the two extremest termini alone enter, namely, the beginning and the end; everything else

takes place in the physiological domain, whether it be a question of doing or preventing, of producing a movement or effecting an inhibition.

Attention is a momentary, provisional state of the mind ; it is not a permanent endowment, like sensibility or memory. It is a form (the tendency to monoideism) imposed upon a subject-matter (the ordinary course of states of consciousness) ; its point of departure lies in the chance of circumstances '(spontaneous attention) or in the fixing in advance of a determinate aim (voluntary attention). In both cases, emotional states, tendencies, must be awakened. In this we have the primitive *direction* of attention. These lacking, all else miscarries; if they vacillate, attention will be unstable ; if they do not continue, attention will vanish. A state of consciousness having thus once become preponderant, the mechanism of association enters into play in its multiple forms. The work of "*direction*" consists in choosing the appropriate states, and in maintaining them (by inhibition) within our consciousness, in order that in their turn they may fructify, and so onward through a series of selections, inhibitions, and consolidations. Attention can accomplish nothing more than this ; in itself it creates nothing, and if the brain be sterile, if the associations are poor, it will act its part in vain. Voluntarily to direct one's attention, is for many people an impossible task; contingent, for all.

III.

Every one knows by experience that voluntary attention is always accompanied by a feeling of effort, which bears a direct proportion to the duration of the

state and the difficulty of maintaining it. Whence does this feeling of effort come, and what does it mean?

Effort from attention is a particular instance of effort in general, the most common and best known manifestation of which is the effort that accompanies muscular work. Three opinions have been propounded to account for the origin of this feeling:

First, that it is of central origin-anterior to movement, or at least simultaneous therewith; that it passes from within to without; that it is centrifugal-efferent; the feeling of energy being displayed; not resulting, as in sensation proper, from an external influence transmitted by the centripetal nerves (Bain).

Secondly, that. it is of peripheral origin-posterior to the movements produced; that it passes from without to within; that it is afferent; the feeling of energy that *has* been displayed; that, like every other sensation, it is transmitted through centripetal nerves from the periphery of the body to the brain (Charlton, Bastian, Ferrier, W. James, etc.).

And, thirdly, that it is both central and peripheral: a feeling of force exerted, or feeling of innervation, and also a feeling of movement accomplished; that first it is centrifugal, and then centripetal (Wundt). This composite theory also seems to be **that** accepted by J. Müller, one of the first who studied this question.

The second thesis, which is the most recent, appears the most tenable one. It has been very carefully expounded by Mr. W. James in his monograph "*The Feeling* of *Effort*," (1880), in which the thesis of the feeling of energy developed prior to movement, has been criticized with great acumen. The author, in discussing the facts successively involved, has

pointed out, that if in cases of paralysis of a part of the body or of an eye, although the member remains motionless, the patient have the feeling of energy developed (which seems to justify the thesis of a feeling of a central innervation anterior to movement), it is because a movement is really produced in the other part of the body, in the corresponding limb, or in the eye which has not been paralyzed. He concludes thence, that this feeling is a complex afferent state resulting from the contraction of muscles, the extension of the tendons, the ligaments, and the skin, fromcompressed articulations, from an immovable chest, closed glottis, knit eyebrows, set jaws, etc.; in a word, that, like all sensations, it is of peripheral origin. Even for those who can not accept this thesis as definitive, it is certain, that it explains the facts far more satisfactorily and far more in conformity to the general laws of physiology than the hypothesis which connects this feeling with the motor nervous discharge-the motor apparatus being insensible in the centripetal direction.

Let us examine, now, the particular case of effort accompanying attention. The earlier psychologists limited themselves to establishing its existence, but they do not explain it. They speak of it only in vague, mysterious terms, as of a "*state* of *the soul*," and of a hyperorganic manifestation. They see in it "an action of the soul upon the brain, designed to set the latter into activity." Fechner, I believe, is the first **(1860)** who attempted a precise localization of the different forms of attention, by referring them to definite parts of the organism. The following passages of his I have deemed worthy of citation as an attempt at explanation :

"The feeling of the effort of attention in the various

organs of sense seems to me to be but a muscular feeling (*Muskelgefühl*) produced upon the setting into motion, by a kind of reflex action, the muscles that are connected with the different sensory organs. The question then arises : With what muscular contraction can the feeling of effort in attention be connected when we strive to remember something? My internal sense gives me a definite answer to this question. I experience a very marked sensation of tension, not in the interior of the cranium, but a tension and a contraction as if of the skin of the head, and a pressure from without inward over the whole cranium, evidently caused by a contraction of the muscles of the skin of the head-circumstances which perfectly agree with such expressions as "to rack one's brains, one's head" (sick den *Kopf zerbrechen*), "to collect one's thoughts" (den *Kopf zusammennehmen*). During an illness from which I once suffered, I was utterly unable to endure the slightest effort of continuous thought (and at the time in question I had not adopted any particular theory); during this illness the muscles of the skin, and particularly those of the occiput, got into a very marked degree of morbid sensibility, every time I attempted to reflect."

In the following passage Fechner describes this feeling of effort, first in sensorial attention and then in reflection :

"If we transfer our attention from the domain of one sense to that of another, we at once experience a definite feeling of change of direction-a feeling difficult to describe, but which any one can reproduce by experiment. We designate this change as a tension differently localized.

"We feel a tension directed forward in the eyes,

directed sidewise in the ears, and varying with the degree of attention, according as we look attentively at, or listen attentively to anything. This is why we speak of the effort of attention. We very clearly feel the difference when we rapidly change the direction of attention from the eye to the ear. In the same manner the feeling is differently localized according as we wish to smell, taste, or to touch anything carefully.

"Whenever I wish to represent to myself as clearly as possible any recollection or image, I experience a feeling of tension very much like that of attentive vision or attentive audition. But this quite similar feeling is localized in a manner totally different. While, in the attentive vision of real objects as well as of successive images, the tension is felt in front, and while in bringing attention to bear upon the other sensorial regions, it is only the direction toward the external organs that changes, the rest of the head not giving any feeling of tension-on the contrary, in the case of recollection and of images, I become conscious that the tension withdraws completely from the external organs of the senses, and seems rather to occupy the part of the head which the brain fills. If I wish, for example, vividly to represent to myself an object or a person, such object or person seem to be brought to me all the more vividly in proportion as I strain my attention not forward, but, as it were, backward." *

Since the time at which Fechner's work appeared, the researches, already mentioned, of Duchenne, of Darwin, and of the various authors that have studied the movements of expression, have imparted much greater precision and clearness to this subject. The

* *Elemente der Psychophysik*, Vol. II, pp. 490 and 475.

part sustained by the respiratory movements, of which Fechner does not speak, is also to be noted. The movements of respiration are of such great importance, that in certain cases they engender of themselves the feeling of effort. Ferrier has shown this by a very simple experiment. If one stretches out one's arm, and holds the index-finger in the position required to fire a shot from a pistol, one can experience even without actually moving his finger the feeling of energy developed. Here, then, is a clear case of the feeling of energy developed, without real contraction of the muscles of the hand, and without perceptible physical effort (which is Bain's thesis). "But, if the reader repeat the experiment and carefully give heed to the state of his respiration, he will observe, that his consciousness of effort coincides with a fixation of the muscles of the chest and that he closes his glottis and actively contracts his respiratory muscles in proportion to the sum of energy felt to be exerted by him. Let him place his finger as before and *continue to* breathe the whole time, and he will find, that however much he directs his attention towards his finger, he will not feel the slightest trace of consciousness of effort until the finger itself has been actually moved, and then it will be locally connected with the muscles that act. Only when this essential, ever present, respiratory factor has been set aside, as in the latter instance has been done, can consciousness of effort acquire any degree of plausibility in being attributed to the centrifugal current."

To sum up, muscular contractions are found everywhere and at all times. Even in cases in which we remain motionless, we will find, if we carefully observe, that intense reflection is accompanied by an in-

cipient word, motions of the larynx, the tongue, and the lips. In people that do not belong to the motory type-such, consequently, as are most unfavorable to our thesis--there is a state of ideal audition, or of ideal vision : the eye, although closed, is fixed upon imaginary objects. Czermak, and after him Stricker, have pointed out, that if after having inwardly contemplated the image of an object supposed very'near, we abruptly pass to the mental vision of a very distant object, we will feel a marked change in the state of innervation of the eyes. In real vision, in such a case as this, one must pass from the state of convergence to the state of parallelism of the visual axes, that is, one must innerve the motor muscles of the eye in a different manner. The same operation, though weaker and in a nascent stage, takes place in that internal vision which accompanies reflection.' Finally, with all persons and in all cases, there are modifications in the rhythm of respiration.*

We can now answer the question above put, namely, What is the origin of the feeling of effort in attention, and what does it mean ?

It has its origin in the physical states now so often enumerated-the necessary conditions of attention. It

* M. Guge (of Amsterdam) has recently given the name of *aprosexy* (from à, not, and προσέχειν, to give attention) to the incapacity of fixing one's attention on a certain object by reason of a diminution of the nasal respiration due to certain circumstances, such as adenoid tumors in the pharyngo-nasal cavity, polyps of the nose, etc.-A child, seven years old, had succeeded in learning, during a whole year, only the three first letters of the alphabet. Having been operated upon for its adenoid tumor, the same child in a single week learned the entire alphabet. A number of college students, suffering from the same affection, mere unable to learn anything. Their sensation was headache and vertigo every time they endeavored to fix their attention. They were able without fatigue to read a phrase six or ten times, but without understanding what they had read, though not thinking of anything else. This circumstance distinguishes this state from ordinary distraction. (*Biologisches Centralblatt*, January I, 1888.)

is simply their reverberation in consciousness, it depends on the quantity and quality of the muscular contractions, of organic modifications, etc. Its starting-point is peripheral, like that of every other sensation.

This means, that attention is an abnormal, a transient state, producing a rapid exhaustion of the organism ; for after effort there is fatigue, and after fatigue there is functional inactivity.

One obscure point remains. When we pass from the ordinary state to the state of sensorial attention or reflection, an augmentation of work is produced. A man worn out by a long walk, by great mental exertion, or who succumbs to sleep at the end of the day's task; a person recovering from a serious illness; in a word, all debilitated individuals, are incapable of attention, because like every other form of work, it requires a reserve capital that may be expended. In passing from the state of distraction to the state of attention there is, accordingly, transformation of a condition of stress into *vis* viva; of potential energy into kinetic energy. Now this forms an *initial* moment that is very different from the moment of effort felt, which is an effect. This observation is incidentally made; I do not insist upon it. But the investigation of this question cannot be profitably attempted before we have surveyed our subject in its totality.

IV.

Experimental researches upon voluntary attention have confirmed, and imparted greater precision to, certain conclusions, which nevertheless follow naturally

from a correct understanding of the subject. These researches are either direct or indirect, according as they investigate attention in itself, in its individual variations, in its normal and morbid states, or according as they study it as the means and instrument of other researches upon the duration of perceptions, associations, judgment, choice, etc. Attention is, in fact, the fundamental psychical condition of almost all psychometrical researches. *

Obersteiner, to whom attention is essentially a fact of inhibition, found that attention generally requires more time in ignorant individuals than in people of culture; in women than in men, which latter, by their particular mode of life, have developed the power of inhibition; in old people, than in adults and young peopie, which doubtless must depend on a less rapid functional activity.

A series of experiments, performed upon the same person, has given as the average time in the normal state, 133σ†; in case of headache, 171 G; in the state of fatigue and of somnolence, 183σ. In a patient at the beginning of general paralysis the average time was 166σ; at the second period of this malady when the condition of the patient just about allowed experimental investigation, 281σ has been attained, and even 755σ. On the other hand, Stanley Hall, who was fortunate enough to discover a subject that had the power of correctly reacting in the hypnotic state, has established a very considerable diminution of the

*Consult for details and arrangement of experiments: Obersteiner, "Experimental Researches on Attention," in Brain, Jan, 1879; Wundt, "Physiological Psychology," Vol. II, Chap. XVI Exner in Hermann's "*Handbuch der Physiologie*," Vol. II, part II, p. 283, et seqq Stanley Hall, "Reaction, Time, and Attention in the Hypnotic State," in *Mind*, April, 1883.

† σ, the unit in all the figures given, is equal to one one-thousandth of a second.

time of reaction, which passes from an average of 328σ (normal state) to 193σ (hypnotic state)-a result that might have been foreseen, by reason of the monoideism peculiar to the state of hypnosis.

Wundt and Exner have made other experiments upon persons in the normal condition. First, the subject is taken in the state of distraction ; the impression against which he is to react, coming upon him suddenly, and without having been described in advance. Then, the impression to be received by him is described as to its nature and 'its force, but not as to the time at which it is to be produced. Finally, the impression is accurately and completely set forth (both as to nature and time), a definite signal notifying the subject when the impression is to follow. In this upward progression from uncertainty toward certainty, the time of reaction constantly diminishes, as might have been anticipated. Thus, while in the case of distraction it may rise to the enormous figure of 500σ, it falls in the second case to 253σ, and with the signal to 766.

These experiments present to us in the simplest form the statecalied expectant attention or *pre*-attention. They further necessitate a few remarks, with a view to corroborating what has been previously stated.

If, in expectant attention, the *intellectual* aspect be considered, it will be seen that it is a preparatory stage in the course of which the image of an event foreseen or presumed, is evoked. The state of monoideism is formed; with the result that the real event is but the reinforcement of the representation already existing. In some experiments two, almost simultaneous, impressions have been produced, and the question is to determine which is anterior in time. If they are of a different nature, the one auditive (the

stroke of a bell), the other visual (an electric spark), there is a tendency to consider as anterior, first, either the stronger of the two impressions, or, secondly, that toward which our attention during the experiment was directed. While engaged in researches of this kind, Wundt was able, at will, and according to the direction given to his attention, to perceive first now the one and now the other. When the two excitations are of the same nature, only the first is distinctly noticed ; the second passes by unperceived.

If the *motor* aspect of expectant attention be considered, it will be found that this state induces a preparatory innervation of the nervous centres and the muscles, which is liable, at the least shock, to be converted into a real impulsion. Representation alone, in this manner, can produce a reaction, without external cause.

This explosive state is especially produced in cases in which the expected impression is not beforehand determined ; which might be called cases of expectant attention in general. The motor innervation is distributed throughout all the sensorial regions. There is produced a feeling of disquietude and discomfort; of tension, such that a falling body or an accident attending the experiment will bring about an automatic reaction.

When the expected impression is determined beforehand, the path of motor innervation will be traced out in advance ; instead of being diffused, the tension is localized. The time of reaction can become zero and even attain a negative value.

When the reaction is to be effected through different processes, or as the result of different excitations, it is necessary that a change be produced in the cen-

tres that shall produce a change in the direction of the nervous paths-a very fatiguing state. If one persists in reacting, the time will increase enormously, and reach, according to Exner, as high as a second.

We must also mention the experimental researches of N. Lange upon the oscillations of sensorial attention. In the silence of the night, the ticking of a watch, placed at a certain distance, is at one moment not heard and in the next it is distinctly reinforced. The same is true of the sound of a waterfall ; and similar oscillations have been observed with optic and tactile sensations. These variations are not objective ; they can only be subjective. Must we-as is usually done-ascribe them to fatigue of the sensory organs ? Our author does not think so. In his opinion they come from a central cause, and are due to oscillations of attention. When one is attentive to two simultaneous excitations, one optic and the other acoustic, the oscillations, if they are of peripheral origin, ought to be independent of each other. Yet such is not the case ; the two kinds of oscillations never coincide ; they are always separated by a clearly defined interval. What is the cause of this periodicity of the oscillations ? According to Lange it is to be sought in the oscillation of the images that accompany sensorial perception. The reinforcement that in this way exists in attention, is here owing to the fact, that to the present impression is added the image of an anterior impression. Sensorial attention would seem to be an assimilation of the real impression that remains unchanged before us, with the anterior image, which undergoes oscillations. *

* Lange, *Beiträge zur Theorie der Sinnlichen Aufmerksamkeit und der Activen Apperception*," in the *Philosophische Studien*, 1887. Vol. IV, Part III.

It will be seen, in fine, that attention in no respect resembles an independent activity; that it is bound up with perfectly determined physical conditions, that it acts only through the latter, and is dependent on the same.