THE PSYCHOLOGY OF REASONING

BASED ON EXPERIMENTAL RESEARCHES IN HYPNOTISM

BY

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has remained until now unsolved. How can one particular fact prove another particular fact? The old theory of the syllogism had the merit of showing, although by a rough simile, the manner in which the conclusion was proved. It was proved because it was contained in a more general truth, by a phenomenon akin to the incasement of seeds, and the whole mental effort in reasoning was engaged upon drawing, in bringing to light and extracting these conclusions from the premisses, which enclosed them like large envelopes. But as soon as the terms can no longer be considered as containing one another, and the circles of Euler cease to represent the operations of the mind, it becomes necessary to find a new theory of proof.

The mental process in the case of external perception belongs to the class of *unconscious* reasonings. But little importance need be attached to this characteristic; for there is really only one method of reasoning, and the study of unconscious reasoning leads us to conclusions which are applicable to all kinds of ratiocination. These conclusions are: that the fundamental element of the mind is the image; that reasoning is an organization of images, determined by the properties of the images themselves, and that the images have merely to be brought together for them to become organized, and that reasoning follows with the inevitable necessity of a reflex. In order to demonstrate this general conclusion as clearly as possible, we shall systematically avoid all the side issues to which a subject such as this frequently gives rise.

The word *perception* is vague enough. Medical men usually confound perception with sensation; they say of many a patient that he has lost the perception of red or of blue, while they are really speaking of the sensation of these colours. Hume called all states of consciousness perception. In modern times, certain psychologists, M. Janet among others, defined perception as the act by which the mind distinguishes and identifies sensations. We shall adopt in this book the definition given by English psychologists* and we shall designate as perception the act which takes place when our mind enters into relation with external and present objects.

Perception is, from the common-sense point of view, a simple act; it is a passive state, a kind of receptivity. To perceive an external object, our hand for example, is simply to be conscious of the sensations which the object produces on our organs. Some examples will, however, suffice to show that in every act of perception, the mind constantly adds to the impressions of the senses. Everybody knows that we can hear the words of a familiar song clearly, while we are frequently unable to distinguish those of an unknown song, even when both songs are sung by the same voice, a fact which plainly shows the share due to the mind. Instead of our seeking examples, proofs may be produced. Wundt and his pupils have made several experiments on this subject. An unknown sketch, an engraving, is illumined by a series of electric sparks,

*Bain, *The Emotions and The Will*, p. 583.

and it is noted that the perception of this sketch, while very much confused during the first sparks, becomes more and more distinct. The impression produced on the retina is nevertheless the same at each flash; but the perception becomes each time more complete and precise, by the help of the recollection formed in the mind by the preceding perceptions.* One might add some more examples drawn from the perception of space, the complex and secondary character of which has been known to us since the days of Berkeley.

Perception is therefore a mixed state, a cerebro-sensory phenomenon produced by an action on the senses and a reaction of the brain. It may be compared to a reflex, the centrifugal period of which, instead of manifesting itself externally in movements, would be expended internally in awakening associations of ideas. The discharge follows a mental channel instead of a motor one.

But psychology demands a larger measure of precision. It is not enough to say that in every perception there are sensations and something more which the mind adds to the sensations. What is the nature of this addition? This question may be best answered by the study of the illusions of the senses. It is now known that in such illusions the error is not to be imputed to the sensitive organ, as the ancients believed, but to the mind. An illusion is a mixed phenomenon, composed, like the sensory perception of which it is a counterfeit, by the co-operation of the senses and the mind. The

*Experiments cited by M. Lachelier (*Révue philosophique*, February 1885.)

sensory impressions are always what they ought to be, the nature of the external excitant and the state of the sensitive organ being given. The error lies in the co-operation of the mind, in the interpretation of the sensations. Now, the examination of some illusions will be sufficient to show in what this co-operation of the mind consists, and what is to be understood by an interpretation of sensations.

One of my friends, now a university professor, has related to me this story of his youth. One evening, when he was walking alone in a country broken up by large woods, he perceived, in a clearing, a large fire lighted. Then, immediately after, he saw an encampment of gypsies around this fire. There they were, with their bronzed faces, lying on the ground and engaged in cooking. The night was dark, and the place very lonely. Our young man was afraid, he lost his head completely, and, brandishing the stick he held in his hand, he dashed furiously into the gypsies' camp. A moment after he was in the middle of a pond, convulsively clasping a tree-trunk with his arms, and feeling the chill of water which rose as far as his knees. Then he saw a will-o'-the-wisp flickering on the surface of the pond; it was this shining spot which had been the starting point of his sensory illusion.

I owe the following account to another of my friends, Dr. G. A. One day when he was ascending the Rue Monsieur-le-Prince in Paris, he thought he read on the glass door of a restaurant the two words *verbascum thapsus*. This is the scientific name for one of the scrophulariaceæ of our country,

which is commonly called "bouillon blanc." My friend had passed the preceding days in preparing for an examination in natural history; his memory was still surcharged with all those Latin names which render the study of botany so tiresome. Surprised at the inscription which he had just perceived, he retraced his steps in order to verify its accuracy, and then he saw that the tariff of the restaurant bore the simple word "bouillon." This word had suggested "bouillon blanc" to his mind, and this in turn had suggested *verbascum thapsus*.

These are two cases in point. They show us the composition of the element which the mind adds to sensation in the perception of external objects. This element must bear a remarkable resemblance to sensations, since it is indistinguishable from them. The young man who traverses a forest really believes that he sees before him a band of gypsies; all this phantasmagoria comes from a brain rendered delirious by fear; it is a psychological phenomenon which, whatever its nature, is very nearly related to sensation, since it does duty for it. Similarly Dr. A. believes he sees written on the door of a restaurant words which exist only in his mind; for this confusion to be possible it is necessary once again that the mind should have the power of producing, of manufacturing and of objectivizing certain simulacra which in a striking manner resemble sensations.

For several years past these pseudo-sensations have attracted the special attention of psychologists. They are called *representations* in Germany.

In France the prevailing term is *images;* it is this which we shall use.

A definition of sensory perception will form the conclusion of this short introduction: Perception is the process by which the mind completes, with the accompaniment of images, an impression of the senses.

We shall begin by studying these images. Their rôle is of the greatest importance; in many cases they almost entirely efface the consciousness of the sensations which have given rise to them. It is this fact which justified Helmholtz in comparing the perception of external objects to an interpretation of signs. The sensations are the signs; our mind takes no more note of them than is necessary to learn their meaning. The perception of the external world is like the reading of a book; pre-occupied by the meaning, the reader forgets the written characters immediately after they are seen. This neglect of the sensations is proved by several interesting examples. We usually see trees and distant forests in green, with the lines of the hills in gray-blue; the gray-blue is to us the colour of distances. But if, altering the conditions of observation, we view the landscape from beneath our arms or between our legs, the colours immediately lose their relations with the distances of the objects; they appear pure, with their true shades. We then recognize that the gray-blue of the distances is often a fairly deep violet, that the green of the vegetation shades off imperceptibly into this violet through a

greenish blue, and so on. (Helmholtz.) The difference arises from the fact that, under these conditions, the sensations are valued as such, and not as signs, which are merely important because of the images which they excite.

Let us proceed to the study of these images.

CHAPTER II.

IMAGES.

I

WE do not here intend to give a complete theory of Images; such an attempt seems premature. The question is not, in several respects, mature. But we are obliged to devote several pages to the study of these interesting phenomena; for the knowledge of the nature of images cannot fail to throw light upon the problem of the mechanism of reasoning. In short, images, along with sensations, constitute the materials of all intellectual operations; memory, reasoning, imagination are acts which consist, in an ulti mate analysis, of grouping and co-ordinating images, in apprehending the relations already formed between them, and in reuniting them into new relations. "Just as the body is a polypus of cells," said M. Taine, "the mind is a polypus of images."

It is not long since an apparent agreement was reached regarding the psychological nature of images. Some ancient authors, it is true, had already seen what has escaped a number of our contemporaries. Aristotle said that one could not think without a *sensible image*. But many intelligent minds were loath to admit that material signs were essential to the exercise of thought. This seemed to them to be a concession to materialism.

In 1865, at the time when a great discussion on hallucinations was taking place among the members of the "Société médico-psychologique," the philosopher Garnier and some eminent alienists, such as Baillarger, Sandras and others, still held that an impassable chasm separates the conception of an object which is absent or imaginary—otherwise called an image—and the actual sensation produced by a present object; that the two phenomena differ not only in degree, but in kind, and that they resemble each other no more than "the body and the shadow." It is interesting to compare the opinion of these writers with the replies which Galton obtained previously from a large number of scientific men, when he began his great inquiry into Mental Images (Mental Imagery). He asked, in a *questionnaire* which he circulated, whether one was able to represent absent objects mentally by a kind of internal vision—he took a thoroughly English example: the appearance of breakfast when served—and if this entirely subjective representation had common characteristics with the external vision. While uneducated people, women, furnished him with very interesting replies on the nature of mental vision, the scientific men to whom he appealed refused to believe in this faculty, which seemed to them to be merely a figure of speech.

Things have changed since that time. Psychologists and physiologists—notably M. Taine and Mr. Galton*—have endeavored to determine the

*Taine, *On Intelligence*, Part I, book II; Galton, *Inquiries into Human Faculty and its Development*, p. 83.

nature of images, their seat in the brain, and their relations with sensations. They have shown that each image is a sensation spontaneously revived, generally simpler and more feeble than the original impression, but capable of acquiring, under given conditions, an intensity so great as to make us believe that the external object is still seen. The complete demonstration of these truths, which nowadays have finally become trite, will be found in special works; they are now only useful in filling out second-rate psychological treatises.

We may remark in passing that this theory of the image is in no way materialistic; it connects the image with the sensation, making the former a preserved and reproduced sensation. Now, what is a sensation? It is not a material fact; it is a conscious state, like an emotion or a desire. If one is tempted to see a material fact in the sensation, it is because it has a very apparent physiological correlative, the excitation produced by the exterior object upon the organ of the senses and transmitted to the brain. But it is known that all mental phenomena are accompanied by a physiological phenomenon. That is the law. The sensation and the image do not differ in this respect from other states of consciousness.

The development of images is very variable. It varies, according to Galton, with race. The French, he says, appear to possess this gift, as attested by their talent for organizing ceremonies and fêtes, their aptitude for strategy, and the

clearness of their language; *figurez-vous* is an expression which is often met with in French. Age and sex appear likewise to be of importance. The power of visualizing is more developed among children than among adults, among women than among men. There are probably some children, says Galton, who pass years of difficulty in distinguishing between the objective and the subjective world—that is to say, between sensations and images.

But it is important, first of all, to distinguish the different kinds of images, which are as numerous as the different kinds of sensations. Each sense has its images, these being therefore visual, auditory, tactile, motor, etc. We are able, when we exercise our memory on an object, to cumulatively employ every kind of image, or to have recourse to only a single kind. Every person has his own habits, depending on the nature of his organism.

We must therefore distinguish several varieties of individuals, several types.* Common experience made this distinction long ago as far as memory is concerned; it is recognized that there is often, in the same man, a natural inequality in the different forms of memory; a certain person recollects sounds best of all, another colours, a third figures and dates, etc. Pathology has proved the independence of these partial memories, showing that some may disappear and leave the others intact. Thus it is that a man may lose the single memory for words, or forget a single language, or be deprived solely of

*The idea of distinguishing several sensory types is due to M. Charcot, who has explained it in his lectures on Aphasia, at the Salpêtrière.

his musical memory, etc. M. Ribot has made a very complete study of these partial amnesias.

We are thus prepared to study the sensory types. It must be understood that this inequality of the kinds of memory depends upon a more general cause, the inequality of the kinds of images; that those individuals who have, for example, a good visual memory, are those in whom visual images predominate; that consequently it is not merely the visual memory that is most conspicuous in them, it is also the visual reasoning, the visual imagination, etc. One may call these people *visuels*. There are thus several types, characterized by the predominance of one order of images in the mental routine.

One of the most common types is certainly the *indifferent type*. In those who belong to this class no one kind of image is more developed than the others. When they wish to recall a person, they see in their minds the form and colour of his figure as clearly as they hear the sound of his voice. The visual memory is equal to the auditory memory; these two memories may besides be very well developed, or may have remained rudimentary, but in every case they are of equal value. The *indifferent* also, in his reasonings, in his imaginings, in his dreams, employs the different kinds of images in equal proportions. This is perhaps the most frequent type; it is the normal type, the approach to which must be expected, since it infers a harmonious development of all the sensory functions.

Alongside the indifferent type must be placed the

visual type, which is also very common. A large number of persons make use almost exclusively of visual images; if, for example, they think of a friend, they see his figure, but do not hear his voice; when they wish to learn a page of a book by heart, they impress upon their memory the visual image of the page with its characters, and in reciting it by heart they have this image before their mind's eye, and read it. When they recall an air, they see distinctly, by the same process, the notes of the score. But it is not only their memory which is visual; all their other faculties are. When they reason, or when they exercise their imagination, they employ visual images alone. The exclusive development of the mind in a single sense permits the *visuel* to perform operations which are feats of skill. There are chess players who, with their eyes shut and their head turned to the wall, carry on a game of chess. It is clear, says M. Taine, that at each move the appearance of the whole chess board, with the arrangement of the various pieces, is present to them as in an internal mirror; otherwise they would be unable to foresee the consequences of the move which has been made against them and the move which they wish to make. Two friends who possessed this faculty often played mental chess games together while walking on the quays and in the streets. Galton tells us that a person of his acquaintance was in the habit of calculating with an imaginary calculating rule, the several parts of which he read mentally according as they were necessary for each of his

problems. Many orators have their manuscript placed mentally before their eyes when they speak in public. Certain painters, designers and sculptors, after they have attentively studied a model, are able to make a copy of it from memory. Horace Vernet and Gustave Doré possessed this faculty. A painter once copied from memory a *Martyre de Saint-Pierre* by Rubens with an accuracy which deceived the connoisseurs. An English painter, mentioned by Wigan, painted a portrait standing, after only one sitting from the model. He held the man in his mind, placed him mentally on the chair, and every time that he looked at the chair he saw the person seated. Little by little his mind became confused; he affirmed that the model had actually sat, and finally he became insane.

Such is the danger of this hypertrophy of the visual image. Those who possess such an intense visualization are half under the influence of hallucination, and it is a hundred to one that the hallucination will some day become complete. We may add that very probably *visuels* are specially predisposed to hallucinations of the sight, and consequently to the forms of delirium of which visual hallucinations are the symptom. According to this theory, a pure *visuel* can never become a *persécuté*, because in the persecution delirium only the hallucinations of hearing are, in general, according to Lasègue's observation, met with. The *persécuté* does not see his persecutors, he merely affects to hear them. We shall see later that there is an objective sign whereby we may recognize whether

an individual does or does not belong to the visual type.

Persons who belong to the pure visual type are exposed, besides, to a serious danger; when they happen to lose, by one of those accidents which pathologists are at present earnestly studying, their faculty of mental vision, they lose everything at the same time. It is impossible, or at least extremely difficult, for them to make use of the other images, which have remained in a rudimentary state. The indifferent type is much better situated; what is lost on the score of sight, for example, is regained on the score of hearing; substitutions are made between the different kinds of images.

M. Charcot has related, in one of his clinical lectures, an interesting pathological case, bringing to light the existence of the visual type and showing the kind of disorder which occurs among these subjects when they lose their faculty of mental vision. We reproduce, with a little abridgment, the observation published by M. Bernard (*Progrès médical*, July 21, 1883).

"M. X., a merchant at A——, was born at Vienna; he is a very well educated man; he knows German, Spanish and French perfectly, as well as Latin and Greek classics. Until the beginning of the affection which brought him to Professor Charcot, he read the works of Homer at sight. He knew the first book of the *Iliad* well enough not to hesitate in continuing a passage the first verse of which had been said before him.

"His father, professor of Oriental languages at

L——, likewise possessed one of the most remarkable of memories. It was the same with his brother, professor of law at W——, with one of his sisters, a distinguished painter; his own son, aged seven years, already knows the most insignificant historical dates wonderfully well.

"M. X. enjoyed until a year ago an equally remarkable memory. Like that of his father and of his son, it was principally a *visual memory*. His *mental vision* gave him, as soon as he wished, the representation of the features of persons, the form and the colour of things with as much distinctness and intensity, he asserts, as the reality itself.

"If he were looking for a fact, a number mentioned in his voluminous correspondence, which was written in several languages, he found them again immediately in the letters themselves, which appeared to him in their exact purport, with the smallest details, irregularities and erasures in their wording.

"When he repeated a lesson at school, or a piece from a favorite author later, two or three readings had fixed the page in his memory with its lines and its letters, and he repeated it while mentally reading the desired passage, which, as soon as he wished, appeared before him with great distinctness.

"M. X. has traveled much. He was fond of sketching the landscapes and views which had struck him. He drew fairly well. His memory gave him, whenever he wished, the most accurate panoramas. If he wished to recollect a conversation, to bring back a speech or a spoken word, the

place of the conversation, the physiognomy of the speaker, in a word, the whole scene, a detail of which was all he sought, appeared to him in its entirety.

"M. X.'s *auditory memory* was always wanting, or at least it never appeared to be other than a secondary matter with him. He has never had, among others, any taste for music.

"A year and a half ago he became worried about some important debts the payment of which seemed uncertain to him. He lost his appetite and his sleep; his fears were not justified by the event. But the emotion had been so intense that it did not subside, as he hoped, and one day M. X. was suddenly startled to find that he had considerably changed. At first there was complete disorder; there was thereafter a strong contrast between his new state and the old. For a while M. X. believed that he was threatened with insanity, so many things around him seemed new and strange. He had become nervous and irritable. The visual memory of forms and colours had in every case, as he was not slow to perceive, completely disappeared, and this knowledge had the effect of reassuring him on his mental condition. He found, besides, little by little, that he was able, by employing other forms of memory, to continue to successfully direct his commercial affairs. He has now resigned himself to the new situation, the difference between which and M. X.'s original situation, described above, may be readily shown.

"Every time M. X. returns to A——, which he frequently leaves on business, it seems to him that he is entering an unknown town. He looks at the

monuments, streets and houses with astonishment, as when he arrived there for the first time. Paris, which he has frequented as often, produces in him the same effect. Memory returns, however, little by little, and at last he again discovers, readily enough, his route in the labyrinth of streets. When asked to give the description of the principal square in A——, of its arcades, of its statues, he says: 'I know that that exists, but I can imagine nothing of it, and can tell you nothing about it.' He had often before drawn the roadstead of A——; now he vainly tries to reproduce the principal lines, which completely escape him.

"His visual memory of his wife and children is powerless. He recognizes them at first no better than he does the roadstead and streets of A——, and even by the time when, in their presence, he succeeds in doing so, he seems to see new traits and new characteristics in their physiognomy.

"He does not go so far as to forget his own person. Recently, in a public gallery, he found himself barring the passage of a person to whom he was about to make his apologies, and who was only his own image reflected by a mirror.

"During our conversation, M. X. complained strongly of several returns of the visual loss of colours. He seemed more concerned about this than about the rest. 'My wife has black hair; I am perfectly sure of that. It is a complete impossibility for me to find that colour again in my memory, as complete as that of imagining her person and her features.'

"This visual amnesia also extends to the things of childhood as well as to more recent things. M. X. no longer knows anything *visually* of the paternal mansion. This memory was formerly very near to him, and he evoked it often.

"The examination of the eye gave completely negative results. M. X. suffers from a myopia as strong as -7D. Here is also the result of the examination of M. X.'s ocular functions made with the greatest care by Dr. Parinaud, in the ophthalmic room at the hospital: No ocular lesions or functional troubles objectively apparent, if there be not always a slight enfeeblement of the chromatic sensibility, affecting all colours equally.

"We may add that no somatic symptoms preceded, accompanied or followed this loss of the visual memory observed in our patient.

"M. X. is now obliged, like almost everybody else, to open the copies of his letters so as to find the information he wants there; and he must, like all the world, peruse them before he comes to the place he is looking for.

"He recollects no more than a few of the first verses of the *Iliad*, and in the reading of Homer, Virgil or Horace he no more than begins, so to speak, to feel his way.

"*He utters, half-aloud*, the figures which he is adding, and he is no longer able to proceed save by small partial calculations.

"When he recalls a conversation, when he wishes to recollect a thing said in his presence, he plainly feels that he must now, and not without

effort, consult his auditory memory. *The words, the recollected speeches, seem to him to resound in his ear, a sensation which is quite new to him.*

"Since this great change occurred in him M. X. has been obliged, in order to learn anything by heart, a series of phrases for example, to read these phrases aloud several times, and thus influence his ear, and later, when he repeats the thing he has learned he has a very clear sensation of *internal hearing* preceding the delivery of the words, a sensation which was previously unknown to him.*

"An interesting detail is that, *in his dreams* M. X. no longer has, as before, the visual representation of things. The representation of words alone remains to him, and these belong almost exclusively to the Spanish language."

The *auditory type* seems to us to be rarer than the preceding types; it is recognized by the same distinctive characteristics. Persons of this type conceive all their recollections in the language of sound; in order to recall a passage they impress upon their minds, not the visual aspect of the page, but the sound of their words. Reasoning is with them auditory, as is memory; for example, when they perform a mental addition, they verbally repeat the names of the figures, and in some way add the sounds, without having a representation of the written sign. Their imagination also takes an auditory form. "When I write a scene," said Legouvé to Scribe, "*I hear;* you see; at each

*I am now obliged, writes M. X. . . . *to say to myself the things which I wish to retain in my memory, while formerly I had merely to photograph them by my sight.*

phrase which I write, the voice of the person who is speaking strikes my ear. You, who are the theatre itself, your actors walk, act before your eyes; I am the *listener* and you the *spectator*." "Nothing could be more correct," said Scribe. "Do you know where I am when I write a piece? In the middle of the parterre." (Cited by Bernard in *De l'aphasie*, p. 50.) It is plain that the *pure auditif*, seeking to develop only one of his faculties, is capable of accomplishing, like the *visuel*, regular feats of memory; for example, Mozart noting down from memory, after two hearings, the *Miserere* of the Sixtine Chapel; deaf Beethoven composing huge symphonies and repeating them to himself internally. By way of compensation, the *auditif*, like the *visuel*, is exposed to serious dangers; for if he lose his auditory images, he is left resourceless; he is completely bankrupt.

It is possible that those who are subject to hallucinations of the hearing and those individuals who are attacked by the delirium of persecution belong to the auditory type; and that the predominance of one order of images creates a predisposition to a corresponding order of hallucinations—and perhaps also of delirium.

We have yet to speak of the *motor type*, which is perhaps the most interesting of all, and by far the least known. People who belong to this type, the *moteurs*, as they are called, make use of, in memory, reasoning and all their other intellectual operations, images derived from movement. To fully understand this important point, it will be sufficient to

remember that all "our perceptions, in particular the important ones, those of sight and touch, imply as integral elements movements of the eye or the members; and that if movement is an essential element when we see an object really, it must play the same rôle when we see it ideally."* For example, the complex impression of a ball, which is there in our hand, is the resultant of optical impressions of the eye, impressions of touch, of muscular adjustments of the eye, of movements of the fingers, and of the muscular sensations which result therefrom.† When we think of the ball, this idea must comprise the images of these muscular sensations, as it comprises the images of the sensations of sight and of touch. Such is the motor image. That its existence was not earlier recognized is due to our knowledge of the muscular sense being comparatively recent; it was never discussed in ancient psychology, where the number of the senses was reduced to five.

There are people who remember a drawing better when they have followed the outlines with their finger. Lecoq de Boisbaudran made use of this means in his teaching of art, in order to accustom his pupils to draw from memory; he made them follow the outlines of the figures with a pencil held at a distance in the hand, thus obliging them to associate the muscular with the visual memory. Galton relates a curious corroborative fact: "Colo-

*Ribot, *The Diseases of the Will*, p. 5. (Chicago: The Open Court Pub. Co.)

†W. James has shown that these muscular sensations are the afferent sensations which proceed from contracted muscles, stretched ligaments, compressed articulations, etc. *The Feeling of Effort*, Boston, 1880.

nel Moncrieff," he says, "informs me that . . . young Indians occasionally came to his quarters, and that he found them much interested in any pictures or prints that were put before them. On one of these occasions he saw an Indian tracing the outline of a print from the *Illustrated News* very carefully with the point of his knife. The reason that he gave for this odd manœuvre was that he would remember the better how to carve it when he returned home."* In this case the motor image of the movements was intended to reinforce the visual image; this young savage was a *moteur*.

Should this process not be generalized and applied to education? It is probable that a child would learn to read and write more quickly if he were trained to trace the characters *at the same time* as they were spelt. The belief that it is impossible to do two things well at the same time is a prejudice. By making reading and writing proceed together, the two memories, visual and motor, are constrained to associate and to aid one another like two horses harnessed to the same carriage.

The motor image enters as an essential element into a large number of mental combinations, although its presence is often unsuspected. The memory of a movement is based upon motor images; when these images are destroyed, the memory of the movement is lost, and, which is more curious, in certain cases even the aptitude to execute it. Pathology supplies us with several examples of this, in motor aphasia, in agraphia, etc.

*Galton, *Inquiries into Human Faculty and its Development*, p. 106.

Let us take the case of agraphia. An educated man, knowing how to write, loses all at once, suddenly, as a result of cerebral accidents, the faculty of writing; his arm and his hand are in no way paralyzed, and yet he is unable to write. Upon what does this powerlessness depend? He himself says: upon his no longer knowing. He has forgotten how he must proceed in order to trace the letters, he has lost the memory of the movements to be executed, he no longer possesses the motor images which when formerly he set himself to write directed his hand. It is possible, thanks to hynotism, to vary the examples of these systematized paralyses, which affect only a particular system of movements, leaving the others intact and the arm completely free. It is in this way that we may make a hypnotized subject lose, by suggestion, the faculty of accomplishing a definite act, such as smoking, sewing, embroidering, laughing, etc. We have often insisted on the advantage which hypnotism offers in this respect, in the study of the majority of motor and sensitive troubles.*

Other patients, struck by verbal blindness, make accurate use of these motor images in order to make up for what they lack in another way. We collect all these examples because the subject is not popularly known; it will be useful if we combine several facts scattered here and there, and endeavour to make a synthesis of them. An individual afflicted by verbal blindness is no longer able to succeed in reading the characters placed before his eyes, although his

*Binet, and Féré, *Les paralysies par suggestion* (*Revue scientifique*, July, 1884).

vision may be intact or sufficiently good to permit of perusal. The loss of the faculty of reading is sometimes the only trouble which exists at a certain time; the patient who is thus maimed may, however, succeed in reading, but indirectly, by means of a roundabout method which he often discovers for himself; all he has to do, in order to understand the meaning of the characters, is to trace them with his finger. What happens in a case such as this? By what mechanism can he establish a substitution between the eye and the hand? The motor image gives us the key to the problem. That the patient is able to read, in some way, with his fingers, is because he receives, in describing the characters, a certain number of muscular impressions which are those of writing. We may say at a stretch, the patient reads while writing (Charcot); that is, the graphic motor image suggests the meaning of the characters according to the same standard as the visual image.

We have just seen the place which the motor image occupies in the sphere of sight and in the sphere of movement. Its rôle is no less important in the sphere of hearing. There are persons in whom the mental representation of a sound is always a motor image of articulation. M. Stricker is one of the number. He it is who was the first to make the particulars of this subject known. The following are the principal proofs he has employed: "When I form," he says, "the image of the letter P, the same sensation is produced in my lips as if I were really about to articulate it. If I think of the

letter R, I experience the same sensation at the base of the tongue as if I expressly wished to utter that consonant. In my opinion, this sensation constitutes the essence of the image of sound." Such is the first proof; the second is that it is impossible to imagine a letter at the same time as the muscles used in articulating it are given a fixed position which prevents them from entering into action. One cannot think of the letter B, which is a labial, while the mouth is held wide open, a position which hinders the movement of the lips. Finally, the third proof is that one cannot have at one and the same time the representation of two letters, A and U for example, when the muscles which are employed in articulating them are the same. "Whoever," he says, "is capable of simultaneously producing, by constraining his breathing for a sufficient interval, the sounds A and U, is justified in regarding my theory as null and void. I need do no more than appeal to the judgment of the reader. Such a simultaneity is absolutely impossible, since the very muscles employed in the formation of the auditory image of A must also be used in forming that of U. Now, I could not innervate them simultaneously—as would nevertheless be necessary—in one manner for the sound A and in another manner for the sound U."

To make this quite clear, it must be remarked that M. Stricker's experiments are in no way concerned with the visual image of letters; it is evident, for example, that one may graphically represent to one's self the letter B while the mouth is kept open;

but that is not the question. M. Stricker meant, by the representation of a letter, the auditory representation alone, that which constitutes internal speech. This author maintains that what is taken to be an auditory image, that is to say, an enfeebled repetition of the sound which is heard when a given letter is pronounced, has nothing to do with the sense of hearing; it is a motor image, a beginning of an articulation which stops before reaching its end.

Objections have been raised to M. Stricker's work by M. Paulhan, who entirely disputes the facts advanced. M. Paulhan has performed all the *experimenta crucis* laid down by M. Stricker, and he states that he can do a large number of the things which M. Stricker declares to be impossible. "I find," he says, "that I am able, while *pronouncing* the letter A *aloud*, to represent to myself mentally the series of vowels, and even to imagine an entire phrase; I conclude from this that, since under these conditions—that is to say, the muscles used in pronouncing A being innervated—the motor image of the other vowels cannot be produced, I conclude from this, I say, that the image of the other vowels and of the other words is not, *at least for me and those who feel like me*, a motor image."

What does this difference of opinion prove? Simply that the two observers have different images and belong to different types. M. Stricker belongs, for a certainty, to the motor type; he is so to this degree that he does not even conceive that others might be constituted differently. It is by virtue of the exaggeration, the abnormality which the phe-

nomenon presents in him, that he has discovered a fact which no one had noticed. But as we have always the defects of our qualities, M. Stricker completely ignores the rôle which sight and hearing play in the recollection of words, and he attributes everything to the motor image. He even goes as far as to make this astonishing observation: "I have not yet met any one who could have said to me that he imagined the contents of a newspaper article with the printed characters which composed it. One may remember several articles by heart, several phrases, but as words which are pronounced internally, and not as graphic images of words which might be read in the memory, as on the printed page." It would be difficult, one will admit, to write anything more false. All the *visuels*, and they are many, do what M. Stricker declares to be impossible. This is a good illustration of the remark that everybody, in philosophizing, gives us the theory of his own nature.

On the other hand, it is probable that M. Paulhan and those who feel like him belong to the purely auditory or the indifferent type. Such is the very simple solution which may reasonably be given to this little debate.*

II.

The theory of the Image was at the point at which we have just left it when M. Féré and myself approached the study of this phenomenon.† We

*Stricker, *Le langage et la musique*, Alcan, 1885; for the discussion with M. Paulhan, see *Revue philosophique*, years 1883 and 1884, *passim*.

†*Théorie des hallucinations* (*Revue scientifique*, January, 1885).

introduced experiments in hypnotism, which enabled us to settle a number of undecided questions; from these experiments, which we shall briefly recapitulate, there follows a consequence which is important in connection with the seat of images. Hitherto we have refrained from defining this seat; and we might yet with advantage maintain, while adhering to what has preceded, that the image is simply localized "in the soul" and possesses, as has been said, a purely spiritual existence. But this is not the case; there exist precise, proved and incontestable facts which demonstrate that the image—or rather the corresponding nervous process —has a fixed seat in the brain, that this seat is the same for the image and the sensation, and that, finally, to sum the whole matter up in a single formula, *the image is a phenomenon which results from an excitation of the sensory centres of the cortex.*

We shall therefore expound what might be called a physiological theory of the image, or at least, if the phrase is too pretentious, a series of experiments which treat of the physiology of the image. These experiments were made in M. Charcot's clinical laboratory at the Salpêtrière, on young hysterico-epileptic girls, who were completely hypnotized according to the ordinary and frequently described processes.*

We know that is possible to produce hallucinations of all the senses in hypnotized subjects during

*For further details, I refer the reader to the work which I have written in collaboration with Dr. Féré: *Le magnétisme animal* (*Bibliothèque scientifique internationale*, Alcan, Paris).

certain stages of the trance, and especially during somnambulism. These induced hallucinations form one of the most familiar psychical symptoms of hypnotism. The voice is generally used to produce them. When the subject is suitably prepared, when the right moment has come, we have only to say to him, authoritatively, "There is a serpent," for him to see it crawling before him. This hallucination is subjective, personal to the subject, and consequently may be easily feigned; but it presents so many objective characters that its existence cannot be doubted, at least in the cases in which these characters are present. Therefore we shall not stop to discuss the hypothesis of simulation again; in proportion as we proceed with our exposition, the reality of the phenomenon will be proved.

How can the experimenter excite hallucinations by speech? How can he make the subject come to *see* a serpent or a bird merely by what he says to him? Can this phenomenon be explained? And is there any analogous phenomenon in the normal life of a wide-awake individual? Such are the questions which a psychologist should, in view of these experimental hallucinations, put to himself. We raise these questions because, while investigating them, we shall show how experiments in hallucination may be useful to the theory of Images.

When, during a conversation with a wide-awake person, we speak to him of the colour red, and he understands the meaning of that word, we raise an image in his mind, the image of red, by virtue of the association which has been established by educa-

tion between the word and the idea; but this created image is generally very feeble, very pale; after being barely caught sight of, it vanishes, like a "super" who has merely crossed the stage. The word has excited in the wide-awake person a vision of red, but a short, rapid and defective vision. Different circumstances may render the vision more durable and more powerful, even during the waking state. Here is a striking example of this. It is related that on the evening of the execution of Marshal Ney, several people were assembled in a Bonapartist room; suddenly the door opened and the servant, mistaking the name of one of the arrivals, who was called M. Maréchal Ainé, announced aloud: "Monsieur le Maréchal Ney." At these words a thrill of fear ran through the gathering, and those who were present have since related that for an instant they distinctly saw in M. Maréchal, Ney himself advancing in person into the middle of the room. Here we touch upon the suggested hallucination, if the phenomenon does not actually belong to that class. The hallucinations which are produced in the hypnotic state by the voice of the experimenter do not possess a different mechanism. The voice of the experimenter excites the auditory centre of his subject, and this centre, once awakened, transmits its excitation to the visual centre, by virtue of pre-established dynamical associations. Then the visual image arises and obtrudes itself with so much the more energy that it reigns alone in the consciousness of the patient; the part of his brain which is excited is the only part

which reacts, and it consequently gives its maximum. But let us put aside these particular conditions which make the image evoked so intense and transform it into a hallucination. What is important for us to show is the fact that the phenomenon of suggested hallucination in hypnotism is not isolated from ordinary intellectual processes; that, on the contrary, its germ exists in the images which people our mind during the waking state, and that hallucination may definitely be made use of as an exaggeration of the image in studying its properties.

The first fact to which we shall call attention, from the point of view of the physiology of the image, is the effect of achromatopsia or color blindness. It is known that a large number of hysterical subjects display an insensibility which extends over one entire half of the body and divides it vertically into two parts; this hemi-anæsthesia is usually accompanied by more or less pronounced sensory anæsthesias; on the insensible side the hearing is enfeebled, the nostril smells odours with difficulty, and one-half of the tongue cannot distinguish the tastes of the foods which are placed upon it. But what really interests us most is the state of the eye. This organ shares with the others in the insensibility. In most cases a concentric contraction of the visual field is observed, and at the same time the loss or enfeeblement of one or several sensations of colour, in other words, achromatopsia. This loss of colours occurs according to a definite order. The colour which is first lost is violet; green is second; this order is constant in all patients. In the case

of the other colours, two classes, which occur almost equally often, must be laid down; in the one, the patients lose violet, green, red, yellow and blue successively; in the other, the red and blue are inverted, and the series reappears thus: violet, green, blue, yellow and red.

It is interesting to investigate the influence which achromatopsia might exercise upon coloured hallucinations which are suggested during hypnotism. M. Richer was the first to observe that if only the achromatoptic eye of a hypnotized subject is kept open, it is impossible to suggest any coloured hallucinations to her by the medium of that eye. If the patient have lost the colour violet, it is impossible to make violet enter into her hallucinations, and so on. Here are some examples of this:

"*Bar*, in the waking state, is achromatoptic in her right eye. Keeping her left eye closed, we make her see a flock of birds. To our questions on the colour of their plumage, she replies that they are all white or gray. If we insist, assuring her that she is mistaken, she maintains that she sees only white or gray birds. But the state of affairs alters if at that moment we open her left eye, whether her right eye be closed or not; she is immediately enraptured with the variety and brilliance of their plumage, in which all the different colours are combined.

"This experiment has been varied in many ways. Closing her left eye we show her Harlequin, and she describes him as all covered with gray, white or black squares. Polichinelle is likewise

dressed in white or gray. "It is original," she says, "but it is not pretty." Immediately upon opening her left eye the notion of colour reappears, and Harlequin and Polichinelle appear to her in motley, as they are commonly represented."*

The same rule appears to extend, as I have shown, to the spontaneous hallucinations of insanity. I have observed a hysterical lunatic, who was a patient of Dr. Magnan's at the Asile Sainte-Anne, continually possessed with the image of a man dressed in red. This woman was hemi-anaesthetic and achromatoptic in the left eye; when her right eye was closed she continued to perceive her hallucination with her left eye, but the man who appeared to her was no longer red; he was gray, and seemed as if surrounded by a mist.

Thus blindness in one colour obstructs the hallucination—that is to say, the image of that same colour. How may this be explained? Very simply, if we consider achromatopsia as a cerebral phenomenon, as a functional disturbance of the cells of the cortex affected by the sensation of colours. Since this functional disturbance places the same obstacle in the way of the hallucination as in that of the sensation of a given colour, it seems probable that the sensation and the image employ the same kind of nervous elements. In other words, the hallucination would take place in the centres where sense impressions are received; it would result *from an excitation of the sensory centres.* What is said of the hallucination applies directly to the image.

*P. Richer, *Études cliniques sur l'hystéro-épilepsie*, p. 708, 2nd. edit.

It will perhaps be objected that there are some hypnotized hysterical subjects in whom achromatopsia does not prevent the suggestion of coloured hallucinations. But it seems to us to be easy to explain this departure from the rule. We shall confine ourselves to remarking that achromatopsia in hysterical subjects depends upon hemi-anæsthesia; that this loss has nothing definite about it; that it is less a paralysis than a paresia, an inactivity of the nervous elements. These elements no longer respond to the call of their normal stimulus, coloured light; but there is nothing astonishing in their reacting when they are attacked from another side, by an excitation which comes from the auditory centres and is nothing else than verbal suggestion.

Other facts may be given to corroborate the localization of the image in the sensory centre. A large number of observations collected by M. Féré show that a constant connection exists between the special sensibility of the eye and the general sensibility of its integuments. When a cerebral lesion causes sensitive disturbances in the integuments of the eye, visual disturbances, such as achromatopsia and concentric or lateral shrinking of the visual field are, on looking a little closely into the matter, likewise met with. In hysterical hemi-anæsthesia, a connection is also observed between the sensibility of the conjunctiva and of the cornea and the special sensibility of the organ; these two sensibilities are always affected to a similar degree. The interpretation of these and many other facts too numerous to be repeated here, has led M. Féré

to the following conclusion: that there exist in undetermined regions of the encephalon sensitive centres which are common to the organs of the senses and to the integuments which surround them.*

Now, if we carefully examine all that happens when a visual hallucination is produced in a hypnotized subject, we see that in many cases the hallucination modifies the sensibility of the external membranes of the eye. In the cataleptic state, the conjunctiva and the cornea, outside the pupillary field, are generally insensible; but as soon as the visual hallucination has been produced, in P—— for example, the sensibility of the external membranes returns to the condition in which it exists during the waking state; the membranes cannot be touched by a foreign body without exciting palpebral reflexes.† With the said M—— the hallucination continues for several minutes on awakening, always producing a dysæsthesia of the membranes of the eye, which lasts exactly as long as the hallucination. With the said Wit——, the unilateral hallucination produces a slight pain in the eye which is alone hallucinated; "I feel as if there were sand in that eye," says the patient. These three observations seem to show that the visual hallucination, or, in a more general way, the visual image, implicates the centre of vision.

But we have not yet approached the most inter-

*Ch. Féré, *Troubles fonctionnels de la vision*. pp. 149, 150 and 151.

†Ch. Féré, *Les hystériques hypnotiques comme sujets d'expérimentation, etc.* (*Arch. de neurologie*, 1883, t. VI, p. 122).

esting observations in this class of ideas. We have yet to speak of the chromatic phenomena produced by hallucinations of the sight.

Let us first of all recall three physiological experiments which may easily be performed without much apparatus. In the first experiment we take a card divided into two equal parts, the one red, the other white, and having at its centre a point for the purpose of fixing the sight; if we gaze at this point for several moments, we see a green colour appearing on the white half. This is the chromatic contrast.* In the second experiment we gaze fixedly upon a little red cross with a black spot at its centre; if we then turn our eyes to a sheet of white paper bearing a black spot, we immediately see a green cross appearing. This is the negative consecutive sensation. In the third experiment we take two cards, one red and the other green, and place them on a table, one a short distance before the other; then, with a sheet of glass held before the eye, we look at one of the cards through the transparency and at the same time try to obtain the reflected image of the other card in order to carry it on to the first; as soon as the images of the two cards are superposed, their colours blend, and we obtain a resultant colour which is generally grayish (the exact tint depends upon the colour of the cards,

*Without wishing to raise any complicated physiological problems here, we may recall the fact that a general agreement does not exist upon the explanation of simultaneous contrast and consecutive images. Helmholtz attributes the effects of the simultaneous contrast to an error of judgment; as for consecutive sensations, he localizes them in the retina, and explains them by Young's theory and that of Fechner. For our part, we entirely share Dr. Parinaud's opinion, which assigns a cerebral seat to those two phenomena, and attributes to them as their sole cause a material modification of the nervous centres. (*Soc. de Biol.*, May 13 and July 22, 1882).

the intensity of the light, etc.). This is the blending of complementary colours.

We may repeat these three experiments with cards coloured by suggestion, that is to say with hallucinations of colour. If, as M. Parinaud has shown, we produce in a patient the hallucination of red on one-half of the white sheet, she sees green appearing on the other half. If, as we have observed along with Dr. Féré, we make a red cross appear on a white sheet, the patient, after having contemplated this imaginary cross for several moments, sees upon another sheet of paper a green cross. Finally, if we teach her to superpose, according to the process described, cards coloured green and red by suggestion, the patient sees the resultant gray tint, which is produced by the blending of these two complementary colours.

In view of these results, is it possible to doubt that visual hallucination results from an excitation of the sensory centre of vision? If it were otherwise, how could we understand that hallucination should give rise to the same chromatic effects as sensation?

We may transfer all these phenomena revealed by the study of visual hallucination to the visual image itself. This extension of experience is so much the more legitimate since Wundt has shown that the simple image of a colour, contemplated for a long time in the imagination, gives rise to the consecutive sensation of a complementary colour. If we, in our minds, gaze fixedly for some moments at the image of red, we perceive, on opening our

eyes upon a white surface, a green tint.* It is difficult to repeat this experiment, for it demands a power of visualization which everybody does not possess. To take myself as an example, I cannot imagine a colour clearly; I am a *visuel* of a very mediocre type. Therefore it is not astonishing that I fail to obtain a consecutive coloured sensation. But my excellent friend, Dr. Féré, easily succeeds in doing this. He can imagine a red cross so vividly as to see afterwards, on a sheet of paper, a green cross; thus he sees not only the colour, but the form.†

These facts show the strict analogy existing between the sensation, the hallucination and the image: we may conclude from this that whether we have the sensation of red, whether we have the recollection of red, or whether we see red in a hallucination, it is always the same cell which vibrates.‡

So far we have been content to assert that the image has the same seat as the sensation, without seeking to determine anatomically what that seat is. The preceding experiments do not enable us to solve this last question, which is much more complicated and difficult than the first. We might here introduce the principal results of the study of cerebral localization, which seem to show that the sensory centres are situated at the level of the cerebral surface-layers, in a zone still ill-defined, probably

*Cited by Bain in the Appendix to *The Senses and the Intellect.*

†This experiment affords an objective sign which allows us to recognize whether a person belongs to the visual type.

‡All the preceding experiments have treated of the visual image. The reader will judge to what extent it is legitimate to extend the conclusion derived from them to the images of the other senses.

situated behind the motor zone. But we prefer to confine ourselves to the basis of hypnotic experimentation, from which we may still learn something upon this subject. It is a primary fact in the study of hypnotic hallucinations that these sensory troubles, when they have a unilateral form, are transferable by the magnet.* This transfer is accompanied by a certain number of objective signs which exclude all idea of simulation; thus the shifting of the phenomenon is followed, in certain subjects, by a shifting in the inverse direction, then by several other shiftings, phenomena which have been described in connection with the transfer of anæsthesia by the name of *consecutive oscillations;* further, according as the transfer is effected, the patient complains of pains in the head, which oscillate from one side of the head to the other; these characteristic pains, which we have proposed to call transfer pains, are not diffuse; they have a fixed seat, and that a most remarkable one. In the case of hallucinations of the sight, the pain in the head corresponds to the anterior part of the inferior parietal lobule, as M. Féré's researches† in cranio-cerebral topography have enabled us to ascertain; in the case of auditory hallucinations, the painful spot corresponds to the anterior part of the sphenoidal lobe. These two localizations are in perfect agreement with the results of clinico-anatomical reseaches; they therefore deserve to be taken into

*Binet and Féré, *Le transfert psyschique* (*Revue philosophique*, January, 1885).

†Ch. Féré, *Note sur quelques points de la topographie du cerveau* (*Arch. de phys. norm. et path.*, 1876, p. 247); *Nouvelles Récherches sur la topographie cranio-cerebral* (*Revue d'anthrop.*, 1881, p. 468).

serious consideration. The centre of visual sensations has been placed in the inferior parietal lobule, and the auditory centre in the sphenoidal lobe. It therefore seems permissible to consider that visual images and auditory images very probably result from the excitation of these two centres.

We finally reach the same conclusion as Herbert Spencer and Bain, but with the advantage of predicating proofs at our disposal for what these authors considered as merely probable: "The renewed feeling," said Bain, "occupies the very same parts and in the same manner as the original feeling."

III.

We have not yet finished our short study of Images. After having determined their seat in the brain, we shall proceed to indicate their principal physiological properties.

Mr. Spencer calls images *faint states*, in opposition to sensations, which are *vivid states*. The term is correct. The lack of vividness of images is one of the reasons which prevent them from being conveniently observed and which explains why their nature has so long been unrecognized. In order to study them it is necessary to compare them with *consecutive images of sight*, phenomena which follow the impression of an exterior object on the retina.

We know that consecutive images are of two kinds, positive and negative. Place a small red square upon a brightly lighted white surface; look at this square for a second, then shut your eyes

without strain, by covering them with your hand, and you see the red square appearing; this is the *positive image*. Repeat the same experiment by gazing for a long time at the red square, then, on closing the eyes or fixing them on a different point on the white surface, you will see this same square appearing, but instead of being red it will be green, the complementary tint; this is the *negative image*.

The consecutive image constitutes a transition type between the sensation and the ordinary image; it is like the sensation inasmuch as it immediately follows the action of a ray of light upon the retina, and it is like the image inasmuch as it survives that action. The consecutive image is generally fairly intense; it may be experimented upon with more result than the ordinary image.

M. Parinaud has demonstrated the cerebral seat of the consecutive image by the following experiment (*Soc. de Biol.*, 13th May, 1882):

"M. Béclard relates as follows, in his treatise on physiology, an experiment which is little known: 'The impression of a colour upon the retina awakens on the same point on the other retina the impression of the complementary colour. Example: Shut one eye, gaze for a long time with the open eye at a red circle; then shut this eye, open the one which was shut, and you will see a green aureole appearing.' (Edition dated 1866, p. 863.)

"Thus presented, this experiment is open to criticism; its very formula enunciates an error; but, restored to its true meaning, it contains the demonstration of the proposition which I have just put forward.

"In order to give a proper account of the nature of the sensation developed in the eye which has not received the impression, let us first of all see what takes place in the eye which receives the impression.

"Shutting the left eye, for the moment excluded from the experiment, we gaze at a red circle on a sheet of white paper, or better, at a point marked at the centre of the circle, in order to fix the eye better. After some seconds the white background loses its intensity and the colour itself becomes dim. Drawing the circle away without taking our gaze off the point, we see appearing on the paper the image of the circle coloured green and brighter than the background; this is the *negative image.* Shut the eye, and the image, after having disappeared for an instant, is reproduced with the same characteristics.

"Let us now repeat Béclard's experiment—that is to say, at the moment when we draw away the circle, let us shut the impressed right eye and open the left eye, gazing always at the paper.

"The image of the circle does not appear immediately.

"The white of the background darkens at first, and it is only then that the image takes form, coloured in green and brighter than the background. It is the same *negative image*, exteriorized by the left eye, as we recognized in the right eye which received the impression.*

*M. Giraud-Teulon, who has repeated the experiment, attributes the same characters to it (Unpublished note sent to M. Charcot).

"We may produce the same *transfer* with the positive image by varying the conditions of the experiment.

"The exteriorization of the adventitious image by the eye which has not received the impression necessarily implies the intervention of the brain and, in all probability, the cerebral seat of the image itself."*

This experiment on the consecutive image seems to me to be very important for our theory; I have repeated it a very large number of times. In the course of these studies I have noticed some curious phenomena. First of all, the experiment may be made with both eyes open. We gaze at a red cross with the right eye, keeping the left eye open, but preventing this eye from seeing the cross by interposing a screen. At the end of some seconds we shut the right eye; and shortly after the left eye,

*M. Parinaud adduces a second proof, which seems to us much less satisfactory. He remarks that the consecutive image follows the intentional movements of the eye, but is not displaced when the optical axis is deviated by the finger. Now, a retinal image, he says, would be displaced in the mechanical deviation of the ball, as well as in its intentional movements. The conclusion does not seem to us to be just. It is readily admitted in psychology that we perceive the movements of bodies by the eye in two ways: 1st, when the eye is steady and the image of the object changes its place on the retina; 2nd., when the eye is in movement and the image of the object does not change its place on the retina. This last case is that in which we follow a moving object with our eyes, for example a rocket rising in the air. It has moreover been remarked that the state of repose or movement of the eye translates itself into consciousness by the absence or the presence of the sensations which accompany the contractions of the ocular muscles; that is that our consciousness takes account solely of intentional movements. These two rules explain the majority of optical illusions relating to movement. Thus the consecutive images appear to move with the gaze, for in this case we experience muscular sensations which are the sign of the movement of the eye, and, in addition, the consecutive image is not displaced on the retina. When the eye is mechanically deviated, we have no muscular sensations, the eye seems steady; consequently, on the one hand the exterior objects, which are really steady, appear to move, for their image is displaced on our retina, considered as fixed, and on the other hand the consecutive images appear steady, for their image does not change its place at all on our retina, considered as fixed. In short, every object which appears to move with the movements of the eye ought to appear steady when the eye is mechanically deviated, and vice versa. These are the results of our psychical education. No argument, either for or against the retinal seat of the consecutive image can be drawn therefrom.

which has remained constantly open, sees the point on the paper at which it gazes become covered with a faint shadow, and at the middle of this darkened surface appears a green cross.

We must also note the changes which take place when seeing the transferred consecutive image; it appears, as M. Parinaud has very fitly remarked, after a certain delay; it never lasts very long, at least with my eyes; it usually disappears at the end of two seconds, and the paper resumes its original white tint at the same time. But this is not all, and if we keep our eye fixed on the same point we see the paper, some seconds after, darken once more and the image reappear with the same characteristics of form and colour as it had at first. The number of these *oscillations* seems to depend on the intensity of the image; I have often counted three of them.

I have also found that the other eye, the one which has gazed steadily at the red cross, preserves its consecutive image during all this time, and that we can, by opening and shutting our two eyes alternately, see the direct consecutive image and the transferred consecutive image succeed each other.

This succession of the two images allows us to compare them. They do not always have the same characteristics; I have found that there is a fairly decided difference of tint for certain colours. For example, an orange-coloured wafer gives me a consecutive image which is almost blue when seen directly, and almost green when it is transferred;

this difference is maintained no matter which eye is used at the beginning of the experiment. The two images present practically the same tint for other colours.

Another proof of the cerebral seat of the consecutive image is that it sometimes appears long after the impression and in this case it resembles an ordinary recollection. Newton, by an effort of attention, was able to reproduce a consecutive image, produced by gazing steadily at the sun several weeks previously. It is well known, says M. Baillarger, that persons who are in the habit of using the microscope sometimes find objects which they have been examining for a long time reappear spontaneously some hours after they have left their work. M. Baillarger,* having worked some hours daily for several days at preparing specimens of brains with fine gauze, saw all at once gauze continually covering the objects in front of him, . . . and this hallucination was repeated for some days. This is an analogous case to that of M. Pouchet, who saw (*Société de Biologie*, 29th April, 1882), while walking in Paris, the images of his microscopic preparations superposing themselves on exterior objects. This phenomenon is not rare; numerous examples are to be found for the seeking. This reviviscence of the long-expired consecutive image, a long time after the excitative sensation has ceased to act, completely excludes the idea that the consecutive image is preserved in the retina; the preservation is made in the brain, and, very probably,

*Quoted by Taine, *On Intelligence*, p. 53.

when the image reappears, it does not involve the cones and rods of the retina in fresh activity.

We may therefore admit, as a very probable fact, that the consecutive image has a cerebral seat. This conclusion is interesting for the psychologist; because it leads him to establish a parallel between the consecutive image and the image of memory. In what do they differ? First of all, in *intensity;* the consecutive image is so vivid that it may be projected upon a screen and fixed there by drawing. Are there many recollections which could be exteriorized in the same fashion? Then, by the *mode of appearance;* most frequently the consecutive image immediately follows a visual sensation, sometimes it appears spontaneously much later, and it is never excited by a psychical cause, by association of ideas, as are the ordinary images of memory. Observers have been struck with this fact. M. Pouchet has remarked that at the moment when the image of his microscopic preparations rose before his eyes, he was in a cab, chatting with a person who knew nothing of science, and he has been unable to perceive the slightest connection between this image and the subject of his conversation.

The comparison of the consecutive image with the image of memory is of considerable interest; for experiment shows that the consecutive image possesses a certain number of attributes, which further belong also to the image of memory. Thus: First, it changes its place with intentional movements of the eye and movements of the head when the look is fixed; second, it becomes larger when the screen

on which it is projected is drawn away, and shrinks when the screen is brought nearer; third, it is distorted with the inclination of the screen and it lengthens in the direction of the inclination.

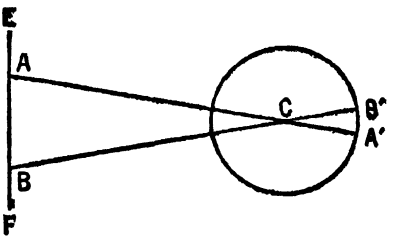
A real image, painted on the screen, behaves quite otherwise. If the screen be drawn away from the eye, this image becomes smaller; if the screen be brought nearer, the image becomes larger; if the screen be inclined, the image is distorted and shrinks in the direction of the inclination. This is what painters call *foreshortening*.* In short, the consecutive image and the real image (the sensation) present inverse properties up to a certain point. What is the reason of this? The question may be readily answered.

Let us first of all suppose, for greater clearness, that the consecutive image has its seat in the retina, with the reservation of modifying our demonstration afterwards to make it agree with the theory of the cerebral seat. We must depart from the principle, so firmly established by Helmholtz, that every subjective sensation is perceived, exteriorized and localized in the same fashion as if it corresponded to an exterior object. Let the consecutive image be A′ B′, on the retina; if it be projected outside, on a screen held at E F, it will have the dimension of the line A B, because that would be the dimension of an object which, placed at the distance of the screen, would make on the retina an image

*It is only after a little exercise that one can succeed in giving an account of these changes in the dimensions of the image, because, as they do not correspond to any change in real dimensions, we have contracted the habit of correcting them.

equal to A′ B′; in fact, the two lines A′ C and B′ C are carried from the two extremities of the image to the optical centre of the eye and produced until they meet the line A B. Now let us alter the distance of the screen, and what happens? As the subjective image is of constant size on the retina, it must assume on the screen the dimension of an object which, situated at the new distance where the screen is placed, would make on the retina an image equal to A′ B′. Therefore we have only to calculate the successive sizes of an object subject to this condition of always producing at the back of the eye a retinal image of the same size, in spite of its changes of distance.

In order to simplify the problem, we shall give the consecutive image the form of a circle; therefore, we may replace the visual angle A C B by a right circular cone, with its vertex at C, and A C and B C as its generating lines. This granted, when the consecutive image is projected on a screen,



the screen cuts this cone, and the size and form of the conic section are those of the object which, at the distance at which the screen is held, produces a retinal image equal to A′ B′; consequently they

are also those of the projected consecutive image. Thus, when the screen is held vertically (that is to say, perpendicular to the optical axis), the consecutive image must have a circular form, because the section is made in a plane perpendicular to the axis of the cone and is of circular form; when the screen is inclined, the consecutive image must lengthen, because the section is oblique and of elliptical form; when the screen is drawn away, the image must become larger, because the section is made further from the vertex of the cone and becomes larger. This is confirmed by experiment.

That this is not so for the real image, painted upon the screen, is because its apparent diameter augments when the object is brought nearer, diminishes when it is drawn away, and diminishes in the direction of the inclination when it is inclined. We shall not dwell upon this point.

One may perhaps be tempted to conclude from this demonstration that the consecutive image really has its seat in the retina, for it would not behave otherwise if it were retinal. But it is to be remarked that the *transferred* consecutive image possesses the same properties. We have several times stated that it enlarges and contracts when the screen is drawn away and brought nearer. Will it be maintained that this transferred image is retinal? Received by the right eye, it is exteriorized by the left eye, which has remained closed until the last moment; it is therefore very probable that it has not impressed the left retina.

"It is rational to admit," says M. Richer on

this subject, "that the retina has an exact representation of itself in the cerebral visual centre. There exists a sort of cerebral retina each point of which is in intimate connection with corresponding points of the peripheral retina."* Therefore it is understood that an impression conveyed directly to a point of this cerebral retina (the consecutive image) produces the same effect on consciousness as an impression which would lie on the corresponding point of the peripheral retina, to right or to left, either above or below, or on the yellow spot.

We willingly admit, until we have proof to the contrary, that the properties of the consecutive image are common to the ordinary image, to recollection for example, although they could not be observed in an image so feeble. But there are cases where the image, evoked by a person of healthy mind, attains a degree of intensity sufficient to exteriorize it. Brierre de Boismont, who endeavoured to impress upon his mind the figure of one of his friends, a clergyman, had acquired the faculty of evoking it whether his eyes were open or shut; the image appeared to him to be exterior, situated in the direction of the line of sight; it was coloured, its outlines were fixed and endowed with all the characteristics belonging to the real person. We earnestly invite those who possess the gift of visualizing to try the following experiment: Think of a red cross, project it on a screen and see if it behaves like a consecutive image, if it enlarges when the screen is brought nearer and contracts

**Études cliniques sur l'hystéro-épilepsie*, 2nd edition, 1885, p. 714.

when it is drawn away. The success of this experiment would give a decisive confirmation to our thesis.

Such are the *positive* characteristics of consecutive images, and probably of all images. They have also a certain number of equally important *negative* characteristics, which serve, as much and more than the first, to distinguish them from sensations.

We know that our sensations are directly modified in consequence of the movements which we make; the aspect of my home is modified when I shut or when I open my eyes, when I come nearer it or go further away, when I press my eyes so as to see double, or when I interpose a prism so as to see it deviated, or when I reflect it in a mirror so as to have a symmetrical figure of it, or when I look at it through an opera-glass so as to have an enlarged view of it. . . . It is clear that none of these experiments has any influence on a mental image. When I think of an absent friend, and the visual image of his countenance is about to rise in answer to my thought, I might try in vain to modify the perspective of this image by changing my position, or to double it by pressing my eye. The attempt equally fails in the case of the consecutive image. M. Parinaud has made an experiment in order to show conclusively that a consecutive image cannot be deviated by looking at it through a prism. We select the following passage from a manuscript note which he has been good enough to send us:

"Gaze steadily," he says, "with one eye at a thin strip of red paper on a white background; after a minute, slip between the strip and the eye a prism with 15 degrees of an angle at its larger base, keeping the gaze fixed, without trying to follow the displacement of the strip. You then see the green consecutive image detach itself from the upper part of the red strip. In order to make sure that it is only the image of the paper that is displaced, and that the consecutive image has not undergone deviation in the inverse direction, recommence the experiment by covering only a part of the red strip with the prism; the consecutive image, if the eye does not change its place, protracts exactly that part of the strip which has not undergone the prismatic refraction."

To sum up, sensations and images form two groups of phenomena which are distinguished by definite characteristics, positive and negative equally.

CHAPTER III.

REASONING IN PERCEPTION.

I

In external perception the images which arise in us from contact with objects derive a group of properties from their origin which are entirely wanting in *isolated* images, which we studied in the preceding chapter. Directly suggested by exterior impressions, they associate themselves organically with these impressions, so as to form an indivisible whole which corresponds to the idea of a single object. By means of this sensory bond each image consequently undergoes all the modifications which the sensation directly experiences. Practically, as regards the observer, it behaves like a true sensation.

The chapter which follows might therefore be entitled: "*The properties of images which are associated with sensations.*"

In the study of these phenomena we shall turn once more to hypnotic hallucinations, for in the normal state they are too weak to be observed. But here a preliminary objection arises: How can the hallucination be of use in the study of normal perception, an operation which is produced by a coöperation of the senses and the mind? Is the hallucination not a sort of delirious conception

which arises wholly from a diseased brain? When we say to a hypnotized subject: There is a serpent! and when, looking at the ground, she sees the serpent crawling towards her, what is real, what is objective in this apparition? Such is the objection which may be made *a priori*. But by carefully observing the hypnotic hallucination (the only one we shall refer to), and also by replacing mere observation by experiment, we find that a part of sensation enters, if not always, at least often, into this phenomenon. This is perhaps not an absolute rule, but the case is very common.

Here is a first experiment which proves this: We present a pure white sheet of paper to the subject and say to him: "See, here is your portrait." The subject immediately sees his portrait appearing on the white surface, he describes the pose and the costume, adding to the suggested hallucination with his own imagination, and if the subject be a woman, she is usually dissatisfied, finding the portrait little flattered. One of them, who was pretty enough, but whose complexion was covered with little freckles, said to me one day when looking at her imaginary portrait: "I have a great many freckles, but I have not so many of them as that." When the subject has contemplated the white card for some time, we take this card and shuffle it amongst a dozen cards of the same kind; there are now thirteen similar cards, and we would be unable to recognize the one which carried the hallucination if we did not take care to mark it after having taken it from the hands of the patient. But the

patient has no need of marks; if we offer her the bundle of cards, telling her to look for her portrait, she recognizes the first card, usually without making a mistake; better still, she always holds it out in the same way, and if we reverse the card according to its edges, she sees the imaginary portrait upside down. But there is something still more cogent. If we photograph the white card and show the photographic proof to the patient ten days, twenty days or a month after, she will still recognize her portrait on it.*

The most simple way of explaining this localization of the imaginary portrait is to suppose that the hallucinatory image is associated—in an unconscious manner—with the visual impression of the white card; so that every time this visual impression is renewed it suggests the image by association. There are always some special details on a paper card, however white it may be; we are able to find them with a little attention; the patient perceives them instantaneously by means of her hyperæsthetic visual sense; these details serve her as the point of identification on which to project the image. They are, as it were, the nails which fix the imaginary portrait on the white surface. This is so true that the portrait experiment is more surely successful when ordinary paper rather than Bristol board is used. In a general way the more visible the point of identification, the more durable is the hallucination.

*Clearly the experiment does not succeed every time, but one success is sufficient, under conditions which exclude fraud, to give us the right to take it into account.

We owe to M. Londe, the chemist of the Salpêtrière, the following corroborative fact: Wit—, being in a state of somnambulism, he shows her the engraving of a photograph representing a view of the Pyrenees, with some asses climbing a hill; at the same time he says to her, "See, this is your portrait; you are quite nude." When she awoke, the patient chanced to perceive the engraving, and furious at seeing herself represented in a state too near that of nature, she jumped up and destroyed it. But two photographic proofs, which were carefully preserved, had already been taken from this engraving. Every time the patient sees them she stamps with anger, for there she always sees herself represented as nude. At the end of a year the hallucination still remains.

This exceptionally long survival of the hallucination is clearly explained by the point of identification theory. In reality the photograph presents to the patient an immense number of points of identification, which, being associated with the hallucinatory image, evoke it by accumulating their effects with an irresistible force.* The most curious thing about this observation is that the patient does not see these points of identification, or rather does not take account of their nature, for it is very essential that she should see them so as to project her hallucination; but she does not succeed in recognizing that they form, by their union, a view of the Pyrenees. It is useless to endeavour to lead

*It has been long remarked that one recollection is much more surely recalled than another, when it has a larger number of lines of association at its disposal.

her from her error; her portrait is all she sees on the photograph.

These few examples will be sufficient to show that hypnotic hallucination may, like perception, contain two elements: an impression of the senses and an exteriorized cerebral image. Perception, said Taine, is a true hallucination.*

It is true that the mode of formation is not the same in both cases. The hypnotic hallucination is formed by an image suggested by speech, which is associated with a point of identification, while in perception the image is directly suggested by an impression of the senses. But between these two acts lies a third, which forms a transition between them, the illusion of the senses. The hypnotic illusion of the senses differs in one point only from the hypnotic hallucination, in that it consists of the transformation of an exterior object, while the hallucination creates an entirely imaginary object. Say to a subject, while showing him a hat: There is a cat, or a bird, or a house; and you produce a hypnotic illusion. Pronounce the same words without showing any object, and you suggest a hallucination. But the existence of that object which serves as *substratum* for the hypnotic illusion does not appear to have any importance, since it may be transformed in a hundred ways. The ordinary error of the senses, a trouble so frequent that everybody knows it by experience, takes its place alongside the hypnotic error of the senses. Who has not heard a burglar's step in the creaking of a piece of furni-

†A. Binet, *L 'Hallucination* (*Revue philosophique*, April and May, 1884).

ture; who has not seen a human figure in the confused forms of a landscape by night? These illusions are distinguished from those of hypnotism by their mode of formation. In the hypnotic state the image which transforms the object is suggested by speech, it comes from within; in the normal state the false image is suggested by a defective vision of the object, it comes from without. But apart from this difference, the two are alike. In short, the illusion of the senses is intimately connected with exterior perception, which it in a manner counterfeits. Consequently perception and hallucination are bound together by an uninterrupted series of intermediate states. Thus we are permitted to consider the ordinary illusion of the senses, the hypnotic hallucination, and finally the hallucination, as more and more accentuated distortions of perception. This proved, we proceed to utilize these facts of the morbid state in the study of the normal state.

Brewster was the first to observe that if the eye of a person in the state of hallucination be pressed, the imaginary object is seen double. The fact has been confirmed by observations made by Paterson, Despine and Ball. This last named doctor has reported the most curious example. It concerned a hysterical young girl who, in the crises of natural somnambulism, saw the Holy Virgin appearing to her in a resplendent costume. This miraculous apparition was invariably doubled by ocular pressure; two Virgins appeared before her. M. Féré has in his turn found that by operating on hys-

terical subjects who can be hypnotized it is possible to repeat this curious experiment as often as desired.

How shall this *hallucinatory diplopia* be explained? It is clear that we are unable to double a mental image directly by pressing on the eye. If I think of an absent friend, I shall never succeed in seeing him double by pressing on my eye. If, therefore, the visual hallucination may be divided under these circumstances, that indicates that it is not "altogether image"; in reality it is associated with an impression of the senses—that is to say, with an exterior point of departure; the ocular pressure doubles this point, and the cerebral image shares this doubling consecutively by a sort of rebound.

Now, this is precisely what occurs in visual perception. When we look at an object while touching or pressing on our eye to make it deviate from its normal position, we see the object double; the object, we say. Now, what is an object? A group of sensations and images; the images are therefore doubled, like the sensations; the sensory diplopia is therefore accompanied by a mental diplopia. But the fact is not readily apparent. It would not be noticed, save for the hallucination, which hypertrophies it, rendering the image enormous and reducing the sensation to almost nothing. In this way pathological facts instruct us regarding the normal state. We learn here that in our perceptions the image is so firmly bound to the sensation that it indirectly undergoes its modification; it is doubled when the sensation is doubled.

M. Féré has replaced ocular pressure by a prism. Placing a prism before the eye of a patient in the state of hallucination, he found that the hallucination was doubled as before, and that, further, one of the images underwent a deviation whose direction and value were according to the laws of optics. It will be fully understood that the experiment was made when all exterior objects whose modifications might serve as marks were removed from the visual field of the patient. For example, the patient is inculcated with the idea that a profile portrait is on a neighbouring table. If, without forewarning, a prism be interposed before one of her eyes, the patient is astonished to see two portraits, and the one which is deviated is always placed according to the laws of optics. (Ch. Féré, *Soc. Biol.*, 29th Oct., 1881.) This second experiment, like the first, instructs us regarding the history of our normal perceptions; for normally, when we place a prism before one of our eyes, the objects which we see through the prism appear to us deviated. Now, this deviation of the objects implies a deviation of the images; the prism, under certain conditions, deviates an image. Thus we find, in the centre of the normal life, the germ of this curious experiment in hypnotism.

We have ourselves contributed to the development of these studies by replacing the prism by a large number of other optical instruments. The principle being settled, the experiments offer scarcely any interest save that of curiosity. We shall confine ourselves to mentioning a few, refer-

ring for details to our articles on hallucinations. If, while the patient is contemplating the suggested imaginary object, for example a tree on which a bird is sitting, we place an opera-glass before her eyes, she immediately declares that the tree is becoming very large and is drawing nearer. If, reversing the opera-glass, we make the patient look through the objective glass (the large end), the tree suddenly recedes, shrinks, and the bird becomes completely invisible. The interest of this experiment lies in the remarks with which the patient, in the state of somnambulism, accompanies these changes in the imaginary object. The said Wit— experiences a most lively astonishment every time. When I make her look at a bird perched on the branch of a tree, she does not in the least understand how this bird can be quite near to her one moment and far distant the next. I tell her several times that the bird changes its position, that it flies nearer and then goes away. But she rejects this explanation entirely, with the objection that the tree also appears to occupy different positions. I reply that it is impossible, that the tree has its roots buried in the ground and cannot leave the place where it is planted. Then she concludes that her eyes are out of order, and that it is they which change the apparent distance of the objects. This conclusion is really a very reasonable one, it being stated that the patient does not know that the eye-piece and the objective of an opera-glass are placed alternately before her eyes.

It is important to notice that the hallucination

is modified only when the opera-glass has been adjusted to the sight of the patient. Why? Because it is only then that the opera-glass modifies her visual sensation; it enlarges the surface of the exterior body to which the image is applied, thus enlarging the image, which acts like a drawing on an india-rubber film.

This experiment, like the preceding ones, explains the normal state. Without dwelling on the matter, let us merely remember that in approaching a person our visual sensations are gradually modified; at the same time the images produced by these sensations are modified in the same way. If we are at first very far away, we see a black spot of unrecognizable character; then this spot becomes an object longer than it is broad, then we distinguish a person, then we know it to be a man, then a man of such and such a kind, and finally we recognize a certain man. The images change in proportion as the sensations are modified by our approach; they become more abundant, more definite, and they finally permit an act of individual recognition. Hallucination renders this phenomenon of the induction of sensations into images very apparent.

In other experiments we nave replaced the opera-glass with a lens, which enlarges an imaginary portrait and at a certain distance reverses it, by a bifracting crystal which produces a special and somewhat complicated doubling, and finally by a microscope, which produces a much greater enlargement than the lens. But in these different cases it

is always a matter of the same phenomenon of refraction, and when we know one of them we are able to understand them all.

We shall describe, in conclusion, the mirror experiment. If we produce a hallucination on a fixed point, such as the hallucination of a cat on a neighbouring table, it is possible to get this imaginary object reflected in a plane mirror, provided that this mirror reflects the point on the table where the imaginary animal is seated. The patient consequently sees two cats; both of them are imaginary, but it may be said that the reflected one is still more imaginary than the other. In fact, if the patient is directed to seize these animals, she readily catches the one on the table, but when she wishes to seize the reflected one her hand encounters the front of the mirror, which prevents it from going further. Moreover, observing things more closely, it is noticed that the mirror gives a *symmetrical image* of the imaginary object, as if it were a real object. It is in this way that an imaginary inscription on a sheet of paper is seen *reversed* in the mirror. All these results are explained by the existence of the reflected point of identification.

Here we have a case which clearly establishes the transition between hallucination and perception. It is an example of an illusion of the senses, which happened to be reflected by a mirror. One of my friends has related to me that, starting one night out of his sleep, he saw a human form before his window, which was faintly lighted; shortly after, he

recognized that this apparition represented the Virgin; she was standing, stretching out her open hands, and from each finger proceeded a ray of fire. At the side of the window there was a cupboard with looking-glasses; the Virgin was reflected in the looking-glass like a real object; the second image was absolutely similar to the first; the attitude was the same, the open hands were surrounded by the same luminous aureole. My friend, who is not in the least superstitious, did not allow himself to be deceived by this apparent miracle. On approaching the window he found that the illusion arose from a white cloth hung on the fastening. As was to be expected, the image of the cloth was reflected by the looking-glass.

Although this phenomenon may appear too natural to deserve mention, we mention it because it shows that one and the same rule extends to hallucination, illusion of the senses and to perception. These comparisons are exceptionally instructive in the study of perception.

We now understand that when we see a real object reflected in a mirror there happens something which is analogous to the reflection of a hallucination and of an illusion. The mirror, considered from the point of view of perception, is a sort of repeater; it repeats the visual sensations which the object produces on us directly. These repeated sensations give rise, as if they were direct sensations, to an interpretation, to the construction of an exterior object by the mind—that is to say, definitively, to a suggestion of images. We may

therefore say that in the normal state a mental image is reflected in a mirror when it is connected with a sensation.

We refer the reader who may desire further details regarding these phenomena of optical hallucination to the monograph on hallucination prepared by us in collaboration with M. Féré. The aim which we pursue here is not to study hallucination, but to explain exterior perception by hallucination, which is a very different thing.

II.

Hypnotic experiments on visual hallucinations have enabled us to penetrate in part into the mechanism of our normal perceptions. The principal conclusion which is drawn from them is as follows: When an exterior object conveys an impression to our senses, the mind adds, upon its own initiative, a certain number of images to the sensations experienced. These images, which complete the knowledge of the exterior and present object, do not remain inert and immobile in the presence of the sensations, like two bodies which have no chemical affinity for each other, or like two algebraic quantities which are simply connected by the sign +. It is more than a juxtaposition. In reality a combination of sensations and images is formed, and although these two elements come from very different sources, since one is sensory and the other ideal, they unite so as to form a single whole. This is proved by the fact that every time the

group of sensations is modified, a corresponding modification in the group of images follows. If the sensation be deviated by a prism, the image is deviated; if the sensation be enlarged by an opera-glass, the image is enlarged; if the sensation be duplicated by a mirror and made symmetrical, the image is reflected and becomes symmetrical. This resonance on the part of the image is a phenomenon which occurs every day, every hour and every instant in our sensory perceptions—that is to say, quite close at hand. If we do not notice it, it is because it is too delicate, too slight. To render it more apparent we must have recourse to the hallucination, which magnifies it.

In common with many authors, we shall apply the name *percept* to the product of perception—that is to say, the images of the exterior object which are definitely due to and bound to the excitative sensation.

We have yet to study the bond which unites the sensation to the image. The preceding experiments have proved its existence without making its nature known.

We may consider external perception as a *synthetic* operation, since it results in the uniting of the information actually furnished by the senses to the information furnished by preceding experiences. Perception is a combination of the present with the past. To perceive a body which is actually in the field of vision, to recognize in it a certain form, size, position in space, certain qualities, etc., is to unite in a single act of consciousness actual elements

—that is to say, the optical sensations of the eye—and past elements—that is to say, a crowd of images; it is to make a single body out of these unconnected elements. This is a phenomenon which completely escapes consciousness; by consulting that witness alone, the operation of perceiving an object appears to be an easy and natural act which demands no effort of reflection on our part; that is in reality an illusion. Experiment and reasoning prove to us that in all perception there is *work*.

But the amount of work is not constant; it is clear that it varies according to circumstances. It would be wrong to think that there is only a single kind of perception. Perception is a form of activity which has a very variable nature, for by one of its extreme limits it encloses conscious reasoning, composed of three verbal propositions, and at the other end it becomes identified with the most elementary and automatic acts, such as reflexes. The amount of work expended in perception increases in an ascending series and even becomes very considerable when we approach reasonings in which a sensible amount of reflexion and comparison occurs; inversely, the work decreases when we descend towards reflex actions, without, however, vanishing altogether. It is therefore important to give some examples of the different kinds of perception. Let us begin with the lowest forms.

"First of all,"* says Mr. Sully, in describing the degrees of visual perception, "comes the con-

*James Sully, *Illusions*, p. 23.

struction of a material object of a particular figure and size, and at a particular distance—that is to say, the recognition of a tangible thing having certain simple space-properties, and holding a certain relation to other objects, and more especially our own body, in space. This is the bare perception of an object, which always takes place even in the case of perfectly new objects, provided they are seen with any degree of distinctness. . . . This part of the process of filling in, which is the most instantaneous, automatic and unconscious, may be supposed to answer to the most constant and therefore the most deeply organized connections of experience.

"The second step in this process of presentative construction is the recognition of an object as one of a class of things—for example, oranges, having certain special qualities, as a particular taste. In this step the connections of experience are less deeply organized, and so we are able to some extent, by reflection, to recognize it as a kind of intellectual working up of the materials supplied us by the past.

"A still less automatic step in the process of visual recognition is that of identifying individual objects, as Westminster Abbey, or a friend, John Smith. The amount of experience that is here reproduced may be very large, as in the case of recognizing a person with whom we have had a long and intimate acquaintance. . . . It is further to be observed that in these last stages of perception we approach the boundary line between perception

and inference. To recognize an object as one of a class is often a matter of conscious reflection and judgment, even when the class is constituted by obvious material qualities which the senses may be supposed to apprehend immediately. Still more clearly does perception pass into inference when the class is constituted by less obvious qualities, which require a careful and prolonged process of recollection, discrimination and comparison for their recognition. . . . To say where the line should be drawn here between perception and observation on the one hand, and inference on the other, is clearly impossible."

We may add that perception, in the highest steps of its development, assumes a particular character. In rudimentary perception the mind simply infers from the sensations which it receives by one of its organs (for example, the eye) that the object has yet other properties which the other senses would perceive if it were necessary and if we wished it; thus when we look at a red-hot bar of iron, the red colour revives in us the idea of heat, which we might directly experience by bringing our hand near to the bar. Such a perception amounts to a substitution of sight for touch.

But it is quite otherwise with the more complex perceptions which belong to reasoning properly so called. When we recognize that a plant belongs to the soap-worts or the lilacs by the inspection of a single leaf, when we discover the horn of a young stag, the claw of a wild boar or a wolf, on the mould of a forest track, the sensation received by

our eye evokes the image of objects which we cannot at the moment see. These operations are, however, always of the same kind, images suggested by an actual sensation, and there is no reason to believe that the mechanism of this suggestion is different in the two cases.

To sum up, we may reduce all perceptive acts to two types: specific recognition and individual recognition. It would be interesting to know if individual perception begins by being generic, and only gradually attains, by a regular progression, to its complete development. According to this hypothesis, when we see a person whom we know, we perceive him at first as a solid body, then as a man, and finally as such and such a person. This progressive development exists; it is not only probable, it is real. This is proved by the following experiments in hypnotism.

Among the effects which suggestion is capable of producing in a hypnotized person *systematized anæsthesia* is certainly one of the most interesting. This operation consists in rendering a person or an object invisible to the subject; it is, properly speaking, the isolated suppression of a particular perception.*

We still remember the effects which the first experiment in anæsthesia had on one of our subjects, the said W——. We made this experiment along with M. Féré. W—— being in the trance, we suggested to her that she would not see M. Féré

*Binet and Féré, *Le transfert* (*Revue philosophique*, January, 1885). An analysis of these experiments has been published by M. Richer (*op. cit.*, p. 724 et seq.).

when she awoke, but that she would be able to hear his voice. Upon her awakening, M. Féré places himself before her; she does not look at him; he holds his hand out to her, but she makes no gesture. She remains quietly seated in the arm-chair where she had just awakened; we are seated on a chair by her side. After some time she expresses astonishment at not seeing M. Féré, who was then in the laboratory, and asks us what has become of him. We reply: "He has gone out; you may return to your ward." M. Féré then stands before the door. The patient rises, bids us good-day and proceeds towards the door. Just as she is going to put her hand on the knob she strikes against the invisible body of M. Féré. This unexpected shock makes her tremble; she makes a fresh attempt to go on, but meeting the same inexplicable resistance, she begins to be frightened and refuses to renew the attempt.

We seize a hat which is lying on the table and show it to the patient. She sees it perfectly well, and assures herself, with her eyes as well as with her hands, that it is a real body. Then we place it on M. Féré's head. The hat appears to the patient as if it were suspended in the air. Words could not express her astonishment; but her surprise reaches its climax when M. Féré lifts the hat from his head and salutes her several times; she sees the hat, which is sustained by nothing, describe a curve in the air. At this sight she declares that "this is no miracle," and supposes that this hat is suspended by a thread. Thereupon she gets

on a chair to try and touch this thread, but she does not succeed in finding it. Then we take a cloak and hand it to M. Féré, who puts it on. The patient, who continues to gaze at this cloak with a look of amazement, sees it move in the air and take the form of an individual. "It is," she says, "like an empty manikin." As we speak the furniture moves and rolls noisily from one end of the room to the other (it is only the invisible M. Féré who is displacing it); the tables and the chairs are overturned, then order succeeds to chaos. The things are put back in their places, the de-articulated bones of a skull, scattered on the floor, are brought together and fitted again; a purse opens of itself, and the gold and silver pieces tumble out of it and in again.

This experiment on the invisibility of M. Féré had been made on the 20th of May, 1884. At the end of the proceedings we omitted to render M. Féré visible, which could have been done by hypnotizing the patient again and assuring her authoritatively several times that she could see M. Féré. On the 23d of May M. Féré was still invisible. We wished to bring this phenomenon of anæsthesia to an end by a new suggestion; then we observed a very remarkable thing.

It was first of all found, to the surprise of everybody, that the patient not only ceased to see M. Féré, but had lost all recollection of him, although she had known him about ten years. She remembered neither his name nor his existence. After having put her in the trance we had considerable

trouble in making M. Féré visible to her eyes; once awakened, she at last saw his person again, but, curiously enough, she did not recognize him, and took him for a stranger. It was most comical to see her get angry when M. Féré thee-and-thou'd her when speaking to her. Some days after, the patient had in the ward one of the bad attacks of hystero-epilepsy to which she is unfortunately subject. This attack completely swept away the last traces of the anæsthesia, and consequently the patient recognized M. Féré at last, without suspecting that during four or five days she had taken him for a stranger who was visiting the staff.

We find in this last experiment,* which in a manner happened by itself—these are the best—an interesting application of the *law of retrogression*, the importance of which, in the destructions and reconstructions of the memory, has been shown by M. Ribot. It is really a general pathological law. Systematized anæsthesia consists, from the psychological point of view, in the paralysis of an individual perception. Here we see the anæsthesia disappear little by little, by degrees, sufficiently slowly to allow us to perceive its progress. The patient, who had at first lost the perception of M. Féré completely, begins, under the influence of a curative suggestion, by perceiving his person without recognizing it. The generic perception has reappeared; the individual perception, which is more complex, is still paralyzed; she sees a man without knowing

*We mention only one experiment, but it is not unique. It appears to be the rule that systematic anæsthesia disappears in the manner indicated.

who he is. Then the attack comes, one of those great internal catastrophies which clear away the accumulation of a toxic substance. Then the individual perception reappears, and recognition takes place.

This revival of the perception, which is reconstructed bit by bit, following the order from simple to complex, from the general to the individual, demonstrates the hypothesis which we have advanced; the different orders of perception which are distinguished by the names of generic, specific and individual perception, are only the more or less advanced steps of one and the same process. A perfect *continuity* exists between the simplest perceptions, as for example, the perception of a colour, and the complicated perceptions which verge upon logical and conscious reasoning; and in short a single act, in developing, in evolving, begins by being a simple perception and is transformed by degrees into a complex reasoning.

A comparison will bring this idea into a graphic form. The point of departure of every perception is an impression of the senses; this initial element is like a nucleus around which layers of images are concentrically arranged. But these layers are not identical; the images which the sensation suggests first, and which form the innermost and firmest layer, represent the physical properties of the object, form, size, physical consistence, weight, etc., and its simplest specific properties. The proof of this lies in the fact that these properties are the first to be perceived when systematized anæsthesia begins to disappear. On the contrary, the images

representing the individual characteristics of the object constitute the most superficial and consequently the most unstable layer. Formed last of all, they are the first to disappear under the influence of an inhibitory suggestion.

We have hitherto considered only a single aspect of the percept, describing it as a synthesis of sensations and images. From the logical point of view, the percept is a *judgment*, an act which determines a relation between two facts, or in other words, an act which affirms something of something. We content ourselves with reproducing an example cited by M. Paulhan in a little book which is worth more than many more voluminous works.

"I have a book before my eyes, and I affirm that it is yellow. If we analyze this judgment, we find that what I affirm is the co-existence of a real sensation (the colour yellow) with other sensations which I have or can have (the white colour of the edges of the book, the black colour of the printed letters, sensations of resistance, of weight, etc.). But what is the nature of the act by which I believe these different sensations are united together? There is nothing in the mind save the cohesion of these different sensations. . . . Judgment therefore becomes reduced to an association of images, for the time being indissoluble; it is often accompanied by an affirmation expressed by words thought, pronounced or written (a verbal proposition), but it may exist independently of all expression; it may consist solely of images."*

*F. Paulhan, *La physiologie de l'esprit*, p. 73.

This is the first time we have had to speak of the logical value of an association of images. This question has been treated at length by contemporary English psychologists; we can only refer to their works, where one will find it established that the aim of all judgment is to affirm a relation of resemblance, co-existence or of sequence between two things;* that this affirmation, this belief, this judgment, are the external effects of an internal fact, the association of images present to our minds;† and that, finally, as a general conclusion, every time that two images are closely associated, as for example, the image of a stone thrown in the air and the image of its fall, or even indissolubly associated like the image of a thing possessing resistance and the image of a thing possessing extension, we believe that the things thus bound together in our mind are bound together in the same fashion in reality.‡ This amounts to saying that we exteriorize an *association* of images as we exteriorize an image.

III.

We have just seen that the percept is a complicated structure, made up of sensations and images, and evidently formed of several layers. We are already a long way from the common opinion, according to which the function of the mind which perceives an object is that of the sensitive plate of a

*J. S. Mill. *Logic*, pp. 71 and 73.

†H. Spencer, *Principles of Psychology*, Vol. II, p. 426.

‡J. S. Mill, *Examination of Sir William Hamilton's Philosophy.*

photographic apparatus; in proportion as we get still nearer to the heart of our subject, we shall be more and more convinced of the insufficiency of that comparison.

We have several times, in alluding to the psychological nature of perception, seen in it the result of unconscious reasoning. Although this point is generally admitted by contemporary psychologists, save for some variations and some minor reservations, it forms too important a part of our subject to allow us to accept it without discussion and without proof. This is a question which deserves to be attacked directly.

Before discussing a problem, its terms must be very accurately stated. We do not intend to compare perception with formal reasoning in all particulars. It is plain, if the proposition be understood in that sense, that what we are maintaining becomes a paradox. It is paradoxical to maintain that the act of recognizing an object by sight or touch resembles a syllogism. Therefore we do not go so far as that; and the reason why we dwell upon this matter is in order to beg our critics not to attack us by trying to refute what we have never said. What we do say, what we believe to be true, and what we shall proceed to demonstrate, is that in formal reasoning there are essential characteristics which we again find in external perception; that these two acts, so dissimilar in appearance, have yet the same internal structure, the same *ossature*. To employ a comparison drawn from natural history, external perception is an act of

reasoning in the same way as the amphioxus, which has no vertebrae, is a vertebrate.

To demonstrate this proposition, we may take at hazard an example of external perception and an example of formal reasoning, and compare the two. Let us compare *the perception of an orange* with the familiar syllogism of the schools: *All men are mortal; Socrates is a man, Socrates is mortal.*

When we look at an orange we experience a certain number of impressions. There is at first a visual impression of colour, of lights and shades, formed really by a very complex aggregate of simple sensations. The muscular apparatus of the eye, awakened by the excitation of the retina, becomes the seat of contractions which are accompanied by definite muscular sensations; the contraction of the pupillary opening, the convergence of the axes of the two eyes, the contraction of the muscle of focal adaptation, the movements of the eyes in their sockets, etc., must be noted; there are also the movements of the head, neck and trunk, which are unconsciously performed so as to allow the luminous rays to reach the surface of the retina and the most sensitive part of that surface—that is to say, the yellow spot. These are almost all the real sensations which we receive from the object or in connection with the object; everything else about it is indirectly known, in the state of images.

Thus the direction and the distance of the object —that is to say, its position in space—and its size, are three important facts furnished, not by the senses, but by the mind. This is not all. *We*

believe we see—that is to say, we see by the mind's eye—the spherical form of the orange, its glossy and dotted surface, the juice which it contains, the complicated arrangement of its internal parts, the presence of seeds, and at the same time *we believe we feel* its weight, its slightly elastic consistence, its odour, its taste, and *we believe we hear* its name pronounced.

If we continue to look at the orange, we induce the revival of images relating to its practical utility, to the act of cutting it with a knife, of carrying it to the mouth, of sucking it and throwing away the pulp and the pips.

In short, there is an immense number of images which cannot even be mentioned because they are personal to each observer, and dependent upon his past experience and his scientific education. All these images are revived, to whatever degree, by the presence of the object, and gravitate around that simple impression of a yellow spot, received by the eye.

In a subject whose actions have been rendered entirely automatic, this suggestion of images by an exterior object is so powerful that it translates itself outwardly in a series of acts. We give an umbrella to Wit——, when she is in a state of somnambulism; she takes it, and she immediately shivers as if she felt the approach of the storm; then she opens it and begins to walk in the laboratory, tucking up her skirt and looking at her feet; from time to time she jumps a streamlet. The scene is an exceedingly curious one.*

*For other examples see Richer, *op. cit.*, p. 692 *et seq.*

If we now compare the perception of an orange with an act of formal reasoning having as its object the death of Socrates, what analogy will be discovered?

First.—It is hardly necessary to remark that these two acts belong to indirect and secondary knowledge. When we assert the future death of a living person, basing our assertion on the death of other men, our assertion anticipates the course of events; it is a prevision. In the same way, when we look at an orange and affirm, explicitly or implicitly, it does not matter much, that "this is an orange," we pass beyond, by a mental act, the limit of our actual experience. This is precisely what the preceding analysis aimed at showing. The characteristics of structure, weight, taste, etc., attributed to an orange are not comprised in the visual impression which comes from the orange; to assert their existence is therefore to go beyond the sensation, to accomplish an act which depends upon indirect knowledge. Every perception resembles a reasoned conclusion; it contains, like the logical conclusion, a decision, an affirmation, a belief, relating to a fact which is not directly known by the senses; it is, in other words, a transition from a known fact to an unknown fact.

Second.—The two acts which we are comparing have a common feature in implying the existence of certain anterior intellectual states—that is to say, of recollections. In formal reasoning, these preparatory states are called premisses. Without premisses, there can be no conclusion. Our mind

only accepts this proposition, "Socrates is mortal," because it knows the truth of a different proposition, "All men are mortal." Here there is, besides, a distinctive characteristic of all the indirect processes of knowledge; being indirect, they necessarily demand a proof. It matters little whether this proof be or be not present to the mind at the moment when we make use of it; what is sufficient and essential is that we should have known it. Thus there are many simplified acts of reasoning whose premisses are unconscious. The majority of the inferences which we make daily for the practical needs of life are of this nature. Mr. Spencer gives an interesting example.

"It is stated that Mr. So-and-so, who is ninety years old, is about to build a new mansion; and you instantly laugh at the absurdity—a man so near death making such preparation for life. But how came you to think of Mr. So-and-so as dying? Did you first repeat to yourself the proposition, 'All men must die?' Nothing of the kind. Certain antecedents led you to think of death as one of his attributes, without previously thinking of it as an attribute of mankind at large. To any one who considered Mr. So-and-so's folly not manifest, you would probably say, 'He must die, and that very shortly,' not even then appealing to the general fact. Only on being asked *why* he must die, would you either in thought or word resort to the argument, 'All men die, therefore So-and-so must die.' "

We know, according to Mr. Spencer, that the syllogism represents, not the process by which the

conclusion is reached, but the process by which it is justified; in other words, the syllogism, by conveniently exhibiting the data of an act of reasoning, enables us to see whether we are asserting more than we absolutely know, and whether the conclusion is really involved in the premisses, as we suppose it to be. The example quoted explains this theory.

Returning now to the perception of an orange, we shall have no trouble in proving that this act demands, as does an act of reasoning, logical antecedents. What our eye lets us know directly is the impression of a yellow spot; no one will maintain that we are able, apart from all experience, and by a kind of pre-established mechanism, to conclude from this sensation that there is an orange in our hand, a fruit which we may cut, eat, suck, and which quenches thirst, etc. If no experience had ever intervened, our intellect would see nothing beyond our actual sensation, and there would be no perception, in the proper sense of the word. If, on the contrary, we are able to recognize the orange, it is because our eye has received previous education; it is because we have learned to associate, on other occasions, a certain visual impression (the sight of the orange) with all the other impressions which we formerly experienced when we took the orange in our hands to cut and eat it.

This is therefore the second point of contact between the perception of an exterior object and an act of reasoning. These two acts imply older states, recollections. These logical antecedents are

called *premisses* in reasoning and *anterior experiences* in perception. The premiss of the reasoning analyzed is, "All men are mortal." That of perception might be, strictly speaking, formulated in an analogous fashion: "All spherical bodies of yellow colour and of a certain size are fruits filled with a sweet juice." However that may be, we see that perception consists, like reasoning, in the application of a recollection to the knowledge of a new fact, and ends in the generalization of this recollection.

But that is not all.

If in the majority of reasonings the premisses remain unconscious, in all or almost all cases of perception, the anterior experiences which render them possible are recalled to the mind as little. Thus, when we see a certain yellow spot, we immediately affirm "this is an orange;" there is no conscious return towards the past, and consequently no allegation of proof. It is only if we throw doubt upon the accuracy of our perception that we invoke our past experience, exactly as in our everyday experiences.

Third.—We proceed with our parallel to see how far it is justified. We know that the foundation of all reasoning is the recognition of a *similitude;* reasoning may be roughly defined as the transition from a known fact to a second unknown fact, by means of a resemblance. When we mentally read over the following syllogism, "All men are mortal; Socrates is a man, therefore Socrates is mortal," we pass from a known fact (the mortality of men)

to an unknown fact (the death of Socrates), by virtue of the relation of resemblance which we discern between the two facts; this resemblance forms the object of a special proposition, "Socrates is a man." There is no act of reasoning in the world which does not contain, after the manner of this example, the affirmation of a resemblance; but this affirmation takes different forms and is called by different names: comparison, classification, recognition, etc. We even know that the school of Aristotle compares reasoning to a classification. To conclude that Socrates is mortal would be to put Socrates in the class of men, of whom mortality is an attribute.

The perception of an exterior object implies a similar act of identification. In order to recognize, with the sight alone, that we have before us an orange, it is not enough that past experiences should have formed an association between a piece of yellowish-red colour and certain characteristics of structure, touch, taste and weight; it is necessary, in addition, that a resemblance should exist between the two experiences, past and present; it is necessary that the two pieces of colour should have the same colour, the same tint. We do not generally reflect in order to assure ourselves of this resemblance by a voluntary act of comparison; but it is none the less true that it, the resemblance, must exist. Further, we are, in the majority of cases, very quick to distinguish a real resemblance from a deceptive analogy.

Some authors have also compared perception to

an operation of classifying, as has been done in the case of logical reasoning. According to them, the visual perception of an object would consist of classing the sensation which we experience in the group of analogous sensations which have formerly been experienced. This idea has been developed at length by Mr. Spencer.

In short, perception and reasoning have the three following characteristics in common: First, they belong to mediate and indirect knowledge; second, they require the intervention of truths formerly known (recollections, facts of experience, premisses); third, they imply the recognition of a similitude between the fact affirmed and the anterior truth upon which it depends. The union of these characteristics shows that perception is comparable to the conclusion of logical reasoning.*

This is one of those truths which have been so fully demonstrated that they have found their way into every book. Helmholtz says in this connection: The judgments by which we trace sensations back to their causes belong, by their results, to what are called judgments by induction;† and in support of this contention, he cites the following example: "As in the immense majority of cases the excita-

*We may remark that the existence of so many different definitions of reasoning is due to the fact that each of them considers only one of the forementioned characteristics. Thus, the following definition: *reasoning is a transition from the known to the unknown*, or again, *reasoning is a demonstration*, relates to the first characteristic; the definition: *reasoning is an extension of knowledge already attained*, relates to the second; and the definition: *reasoning is a classification*, relates to the third.

†Induction is inaccurate. In perception, the mind never rises so high as a general conclusion; it simply comes to a conclusion on the object present to the senses. It is an inference from particular to particular, and likewise, in the case where perception is aided by a considerable number of anterior experiences, it is a deduction.

tion of the retina at the external angle of the eye comes from a ray of light which reaches the eye from the nasal side, we think it is the same in every new case in which the excitation affects the same part of the retina, just as we maintain that every man who is at present living must die, because experience has taught us that so far death is the end of all men." We might extract analogous quotations from the works of Mill, Spencer, Bain, etc.

It would be easy to follow up and renew the comparison which we have made between perception and the syllogism, by remarking that if perception is an act of reasoning, the illusion of the senses is a *sophism*. This deduction was made long ago; it has even been attempted to extract the logical rule which is violated by the majority of illusions. We may cite an example, borrowing it from the class of *passive illusions*, which have been very carefully studied by Mr. J. Sully.* If the finger be pressed upon the outside of the lowered eyelid, a kind of luminous ring will appear. This image, which represents the end of the finger, will not be localized at the point where the retina has been excited, but inside and above, towards the upper part of the nose, just at the place where the luminous source which affects the retina at the place touched is *generally* situated. The sophism contained in the unconscious reasoning consists in taking as an absolute law a rule which is only valid in certain cases. Errors of this kind are frequently met with in the physiology of the organs of the senses.

**Op. cit., passim.*

We may now consider it as sufficiently demonstrated that perception is an act of reasoning. We shall not therefore pause to discuss the opinion of some thinkers who insist upon drawing a line between reasoning and inference, and wish to see no more than an inference in perception. According to these writers, inference would be the simple consecution by which the mind passes from one idea to another, as when a Dutchman, traversing a town in India, expects to find a tavern in it; this operation, though a passage from the known to the unknown, would be only a pseudo-reasoning, a sketch which does not deserve the name of the finished work. But there is in reasoning, always according to the same writers, something more in the mind than this bringing together of facts. Reasoning is the reflective act by which the mind adopts a proposition because it sees in it the logical consequence of other propositions which it holds to be true; so that the only rational operation is that in which all the premisses are present to the mind, and where the mind perceives the relation which binds the premisses to the conclusion.*

We reject this arbitrary distinction. Inference or reasoning, it is always the same thing; we have just shown this in the case of perception, where analysis reveals the essential parts of a syllogism. How could it be maintained, after that analysis, that perception is a simple consecution? All that may be granted is that in reality certain reasonings are conscious and that others are automatic. Per-

*Brochard, *Logique de Stuart Mill, Revue philos.*, Vol. XII.

ception is of the second class. But great value should not be attached to this difference. Consciousness accompanies the physiological processes of reasoning, of sensation, of recollection, etc., it does not constitute them; it is an epiphenomenon, and nothing more.* So far as quantitative experiments made on sensations go to prove, consciousness is subject to conditions of duration and intensity. If these conditions are realized, it exists; if not, it is wanting. But in every case it appears and disappears without disturbing the action of the nerve cells, which continues silently in the same necessary way.

IV.

We have just seen that the work involved in every perception is identical with the operation which consists in drawing a conclusion when the premisses are given. At the same time we made a short survey of the nature of this work. Let us go further, and we shall try to give an *explanation of reasoning*.

But before approaching this great problem, to which this book is wholly devoted, let us pause at some preliminary considerations. We intend to give a psychological theory of reasoning. For this theory to be correct, for it to be even acceptable, it is evidently necessary that it should satisfy certain conditions, that it should fit certain psychical facts already known and considered as certain. Psychology is no longer in that state of

*Ribot, *Diseases of the Memory*, p. 36 (Appleton, New York), and *The Diseases of Personality*, Introduction (The Open Court Pub. Co., Chicago).

infancy which every science has known and in which any one may freely erect fantastic explanations which rest on nothing.

In every science which has undergone organization, a new theory has a right to be cited only when it is supported by admitted facts; if, for example, some one pretended to have discovered perpetual motion, it would be right to reject his pretended discovery without examination, for it would be contrary to all the laws of mechanics. Psychology also has its questions of perpetual motion. Therefore, before seeking the solution of our problem, let us put it in the form of an equation, in order to determine the conditions which the solution must satisfy in order to be correct.

First condition.—Stuart Mill remarked that all psychological explanations, without exception, are subject to a general condition; that of being an application of the *laws of association by resemblance and by contiguity.** To explain a psychological fact is, according to Stuart Mill, to show that it is a particular case of the laws of association. We do not intend to inform the reader what is understood by these laws; the subject is well known, thanks to the numerous analyses of English works which we possess. We may merely recall the fact that association by resemblance is the law by which ideas, images and feelings which are alike are called up in the mind. Thus, a portrait evokes the idea of the model. We may also recall the fact that association by contiguity is the law by which two phenom-

*John Stuart Mill, *Dissertations and Discussions*, III, 105 et seq.

ena which have been experienced together tend to associate themselves in our mind, so that the image of the one recalls the image of the other. Such are the laws of association; our cut-and-dried formulae can convey no idea of the immense number of phenomena which these laws explain. However, no one has the right to maintain that these laws are the only ones, and that no others exist. We cannot imagine that we already know *all* the laws of mind. That would be a singular presumption. So we believe that Stuart Mill was too exclusive in saying that all psychological explanations consist in reducing the fact to be explained to the laws of association. What must be retained of Stuart Mill's opinion is that in psychology, as in all other sciences, an explanation ought to plead nothing outside of truths which are at the same time known and established; now, as the only psychological laws which we can at the present time consider as established are those of association, they are the only ones which we may provisionally introduce into explanations. There we have a valuable sign which enables us to distinguish at first sight a serious explanation from those caricatures of explanations which are merely hypotheses built upon other hypotheses.

Second condition.—For the psychologist every verbal proposition resolves itself into an association of images, and the demonstration of a proposition, the reasoning, is the creation of a new association. Reasoning has been very accurately defined by Mr. Spencer as "the establishment of a relation between

two things,'' and he has explained, with a great amount of detail, the meaning and the range of his definition.

We have already had occasion to show that in every perception there is work, and that this work culminates in a synthesis of sensations and images.* The process of perceiving an object, for example an orange, and of recognizing the existence and nature of that fruit when placed before us, consists in associating with a visual impression a certain number of attributes of which we do not take direct cognizance; but to associate two groups of qualities, is to judge; it is, as Mr. Spencer's definition has it, to establish a relation between two things.

This settled, the following question arises: How is this synthesis formed? By what process is a relation established between the two things? How do we pass from an impression of yellowish-red colour received by the eye to the image of all those attributes which characterize an orange? Or again (for we are anxious to show all the aspects of the problem), how *do we judge* that ''this is an orange?''

Third condition.—Mr. Spencer adds a word to the definition of reasoning already quoted. Reasoning, he says, is the *indirect* establishment of a relation between two things. This adjective will be fully understood by means of an example. Let us suppose that instead of confining ourselves to looking at the orange, we took hold of the fruit and occupied ourselves in peeling and eating it. According as we perform these different actions, an associ-

*See pages 70 and 81.

ation becomes formed in our mind between the sight of the orange and innumerable sensations of the hand and of taste; the formation of this relation is *direct*, produced by experience, it comes from without. On the contrary, when we perceive the orange at a distance, without touching it—that is to say, when we *reason* regarding our visual sensation—the relation which is established between this sensation and the mental image of the attributes is *indirect*, in the sense that it is not produced by actual experience, and that it is produced by the operation of other intellectual states—premisses.

Let us express this fact in the precise language of psychology. What is a premiss? It is a judgment, an association of images. Consequently, what is a conclusion which follows from the premisses? It is an association of images produced by other associations.

We may therefore formulate as follows the third question which arises: How can the two complete associations forming the premisses unite to form a third, that which constitutes the conclusion of the reasoning?

We possess the touchstone with which we may make sure whether a psychological theory of reasoning is true or false. Let us try this criterion.

Very few of the existing theories of reasoning are in harmony with modern ideas and merit discussion. The spirtualistic French school, which has on many questions adhered to the old doctrine of entities, generally explains reasoning by a faculty of reasoning; some supporters of this school are not

content with this purely verbal explanation, but they confine themselves to maintaining that reasoning is a simple, irreducible and consequently inexplicable property. It is to be regretted that M. Taine, in his magnificent work *On Intelligence*, gave us a theory of knowledge instead of a psychology of reasoning. In Germany, Wundt places reasoning at the basis of the psychical life; he makes it the foundation of all our thoughts, and goes as far as to say that we might call the mind "a thing which reasons." Thus he tries to discover reasoning even in the primitive and elementary fact of the psychical life, in sensation. But when it comes to taking the mechanism of reasoning to pieces, bit by bit, to explain it according to known laws, a gap is visible in his work. As far as we are able to judge, in the light of M. Ribot's analyses, which are always masterpieces, Wundt has not given us an explanation of reasoning. In England, Stuart Mill concerns himself almost exclusively with the logic of reasoning, he leaves psychology alone; and we know that there is as much difference between psychology and logic as between physiology and hygiene. Alexander Bain, who systematically reduces all mental states to a combination of the laws of association, touches several times upon the question which engages us; but his thought remains vague and irresolute, and, yielding to his habit, he describes instead of explaining.* Only in Mr. Spencer's work do we find a true theory of reasoning.

*See especially, in his excellent book on *The Senses and the Intellect*, pages 524 et seq.

In this case the theory is as complete as could be wished, for it starts from the most elevated type of reasoning and reaches the simplest, including in its immense span compound quantitative reasoning, simple and imperfect quantitative reasoning, perfect qualitative reasoning, imperfect qualitative reasoning, reason in general, perception, and the feeling of resistance. The author has tried to prove that the process which the philosopher follows in his longest and most complicated reasonings is that by which incipient consciousness strives to become thought; that, in a word, a unity of composition exists among all the phenomena of the intellect. What is this unity? The whole study of reasoning may be summed up by defining it as "a classification of relations." But what does the word classification signify? It signifies the act of grouping together like relations. To deduce a relation is to think that it is like certain others.*

Before this theory is discussed it must be made clear. We shall do this by quoting from the author some types of reasoning, and by showing how the idea of a classification of relations throws light upon the mechanism of these operations.

Let us take as an example an "imperfect qualitative reasoning," which treatises on logic commonly give as a syllogism. When we say, "All horned animals are ruminants; this is a horned animal, therefore this animal is a ruminant," the mental act indicated is, according to Mr. Spencer, a cognition of the fact that the relation between the

*Half of the second volume of *The Principles of Psychology* is devoted to the development of this question.

particular attributes in this animal is like the relation between the homologous attributes in certain other animals. It may be symbolized thus:

(The attributes constituting a horned animal.) A			a	(The attributes constituting this a horned animal.)
(coexist with)	}	is like {		(coexist with)
(The attributes constituting a ruminating animal.) B			b	(The attributes constituting this a ruminating animal.)

"The relation between A and B is like the relation between a and b;" such is the formula which, according to the author, really represents our logical intuition. It will be noticed that reasoning thus understood becomes a true proportion, with four terms, a kind of rule of three from which the idea of quantity is excluded. Stuart Mill has reproached Mr. Spencer for making reasoning an operation in four terms, and he has maintained that in reality only three exist. Thus, to transfer the controversy to the preceding example, Stuart Mill has remarked that the reasoning attributes to a certain animal which has horns the *same* attributes (constituting the ruminating animal) as to all the other animals which have horns; consequently, the two terms indicated by the letters B and b make only one, they are the same; three terms exist and not four. Mr. Spencer has replied that as these attributes do not belong to the same animals, but to distinct though similar animals, the attributes also ought to be distinct. The solution of this difficulty is easy to find; it seems to us that Mill is

right. He would have been able to reply to Mr. Spencer: Every horned beast has distinct attributes which make it a ruminant, but the general idea which we have of these attributes is common to these animals; it is the same for all. And thus we succeed in reducing the terms of the reasoning to three.*

That, however, is a trifling matter. Let us admit for a moment the existence of the four terms. It may be granted that reasoning is a classification of relations; but the relations must be formed before they can be classed, for they do not exist before being formed, and we cannot compare what does not exist. The curious thing is that this important question is hardly touched upon by Mr. Spencer, and yet he was the first to recognize that reasoning consists in the establishment of a relation. The few words which he has written on this subject, as if by the way, relate to another example.† Analyzing the following syllogism, "All crystals have planes of cleavage; this is a crystal, therefore this has a plane of cleavage," he inquires how our mind is able to pass from the perception of an individual crystal to the idea of a plane of cleavage; and he prefers to say, in order to explain the establishment of a relation between these two things, which is the essential difficulty of the question: "Before consciously asserting that all crystals have planes of cleavage it has already occurred to me that this crystal has a plane of cleavage." But then, it may be objected, everything is done; the

*Spencer, *Principles of Psychology*, Vol. II, p. 69.
†*Op. cit.*, p. 97, Vol. II.

work of reasoning is accomplished, the relation is established, and it is precisely all this which required explanation. Mr. Spencer himself recognizes this, for he calls this operation, which he assumes to be effected without explaining its genesis, a *primary or provisional inference*. "This act is simple and spontaneous," he says, "resulting not from a *remembrance* of the before-known like relations, but merely from the *influence* which as past experiences they exercise over the association of ideas."* Therefore we see that when it comes to the decisive moment, the theory disappears; it cannot be declared to be either true or false, for it does not really exist.

We have still many other objections to offer. We might ask what, in this comparison of relations, the old relation, that which takes the place of premisses, can add to the new and inferred relation. When I assert that a relation exists between the crystal which I hold and a plane of cleavage, I find, it is true, a confirmation of what I assert, in representing this old relation to myself: All crystals have planes of cleavage. The general rule proves the particular case. But it is precisely this which wants explanation. We have just shown this in stating the equation of a theory of reasoning; the reader will recollect that we made this point the third condition which a theory of reasoning must fulfill in order to be correct. It must be explained, we have said, how a conclusion follows from its premisses; in more accurate language, it must be

*Op. cit., Vol. II, p. 102.

shown how an association between two terms can be formed by the medium of former associations. But Mr. Spencer's hypothesis is powerless to solve this question. What does he tell us? That the mind, after having formed (it is not known how) a relation between a and b, compares it to a before-known relation between A and B. But what can follow from this intuition of a resemblance between the two relations? How can the comparison of the two add to the bond which already unites the terms a and b? This is a question of mental mechanism which has to be solved. Mr. Spencer does not solve it, he does not even suspect it. It is one of the characteristics of the theory we are discussing that it does not touch this question. Mr. Spencer confines himself to proving that the idea that all crystals have planes of cleavage confirms the particular conclusion, this crystal has a plane of cleavage; but, once more, this is merely stating the question. It would be necessary to explain this confirmation of the particular relation by the general relation by introducing the laws of association.

We are sorry to have to deliver such a judgment on a part of the work of a thinker who has done so much for psychology; but it is a duty to judge theories in themselves, without taking into account the fame of those whose names are associated with them.

We shall, in our turn, approach the problem of reasoning, putting forward some observations on a mental law to which we shall often appeal, the law of resemblance.

CHAPTER IV.

THE MECHANISM OF REASONING.

I

THE action of resemblance on the phenomena of the mind has been, so to speak, recognized in all times; it has never been very difficult to discover that one idea suggests a like one. Mr. Bain, who has devoted a long chapter, full of facts, to association by resemblance, enunciates in the following terms the law which governs this association: "Present actions, sensations, thoughts or emotions tend to revive their like among *previous* impressions or states."* This is a very wide formula, for it includes not only ideas, but emotions and actions; nevertheless, it seems to us to be incomplete upon a most important point.

The reproductory action of resemblance — the *attraction of sameness*—is a common and superficial effect, known to us since the days of Aristotle;† resemblance has in reality a second effect, quite as important as the first—that of *fusion*. Alongside the law of suggestion and of recollection by resemblance, we may place the *Law of Fusion*.

It may be enunciated as follows, the demonstra-

*Bain, *The Senses and The Intellect*, p. 463; J. Stuart Mill, *Examination of Sir William Hamilton's Philosophy*, p. 225; Cf. Ribot, *La psychologie anglaise contemporaine*.

†On this subject Hamilton's *Dissertation* at the end of his edition of Reid, may be consulted.

tion being left for later consideration: "When two like states of consciousness are present to our mind simultaneously or in immediate succession, they become fused together so as to form a single state." Thus, when two sounds of the same pitch and the same timbre vibrate at the same time, the most practiced ear does not dissociate them; only a single reinforced sound is heard; each sound loses its individuality in a single resultant. If the two states of consciousness are exactly alike, the fusion is complete; if they present only an imperfect resemblance, implying a partial sameness, the fusion is partial.

The fusion of like sensations.—The best illustration of our law as regards sensations is furnished by the sensations of touch, in Weber's experiment. This experiment shows us the fusion of like sensations; they fuse so thoroughly that a person who has not been told beforehand that he is receiving two sensations produced by two distinct excitations believes, while he experiences only a single sensation, that his skin is bearing only a single pressure. But this phenomenon touches upon a much discussed problem in physiology, upon which we must first of all say some words of explanation.

Among all the senses, touch is the one which occupies the largest surface; while the special senses, sight, hearing, smell and taste, are confined to extremely small parts of the organism, that of touch is found over the whole extent of the skin and even on some mucous membranes; the nasal fossae, the conjunctiva, the buccal cavity, the two extremities of the digestive tube, and the urethral canal

give us sensations of contact. This wide diffusion of the sense of touch over the surface of the body is explained by the fact that touch is the fundamental and primitive sense from which the special senses have been derived by a progressive differentiation, and which perhaps will, in the course of time, give rise to the formation of new special senses. The sense of touch is not equal all over; certain divisions of the general epidermis display a delicacy superior to that of the others. For example, we know that the tactile sensibility is dull on the middle of the back; it is keener on the hand, keener still on the tips of the fingers; the highest degree of sensibility is reached at the end of the tongue. Weber succeeded in *measuring* these differences in sensibility by employing a pair of blunt compasses, the two points of which he shifted over the surface of the body. He found that on the middle of the back the two points are not felt double until they are thirty-nine lines apart (a line =0.88 inch); when closer, the two points produce only a single sensation. On the chest the necessary distance is twenty lines; on the thigh, sixteen; on the lower part of the forehead, ten; on the palm of the hand or the end of the nose, three; on the edge of the lower lip, two; on the tip of the index finger, one; on the point of the tongue, one-half.

These experiments in measurements have given rise to a new problem. It has been asked why two compass points produce, according to their distance apart and the region of the body on which they are placed, sometimes two sensations, sometimes one.

Two explanations have been proposed. The first, simple after the manner of all *a priori* views, consists in saying that where two points are felt, each of them has separately excited a nerve fibre, and that, on the other hand, when we feel only a single point, the points of the compass have excited only a single fibre. In every case we experience as many sensations as there have been nerves excited. A trace of this explanation remains in the language, in the term *cercle de sensation*. If one of the two points of the compasses be pressed on the skin, and if it be tried up to what distance from the first point the second fails to produce a new sensation, an area is thus circumscribed which has the form of a circle or of an ellipse. This area, being capable of receiving only a single sensation, corresponds, according to the theory, to the territory of one nerve fibre; it is called the circle of sensation.

This explanation contains a part of the truth. There is no doubt that the portions of the integument whose sensibility is very delicate are richer in corpuscles of touch than the portions whose sensibility is dull. But this is a very different thing from admitting that every circle of sensation is, as has been said, an anatomical unit, the territory of a single fibre. There are places where the points of the compass may be separated by more than a dozen nerve papillae without producing any more than a single impression. We may add that the limits of a circle of sensation vary strikingly under the influence of attention and of practice; if a circle really corresponded to the province of a single fibre,

this would be an invariable unit. Finally, there is a more conclusive fact than all the others. If two circles of sensation, whose circumferences are tangential, are drawn upon a person's forearm, and if one of the points of the compasses be placed in one circle and the other in the other, the two being brought as near together as possible, the person undergoing the experiment will experience only one sensation; in order to produce two, the points must be separated by the whole diameter of a circle. If it were true that each circle was supplied by a special fibre, it would be sufficient for the two points to be placed upon any points whatever in the two circles for the person to feel both of them.

The second explanation is known under the name of the *theory of nerve fields*. It is observed that for two sensations of touch to be distinguished there must be between the excited points on the skin a certain space, a certain number of nerve ramifications, a nerve field. Only this distance is necessary, and it is sufficient. Why is it so? Because, it is said, two things can only be distinguished if something separates them. The excitation of the two nerve fibres can only produce two distinct impressions if these two fibres are separated by unimpressed nerve elements. These elements, whose rôle is to divide the two sensations, are represented by the distance apart of the two points of the compass.

This pretended explanation seems to us to be simply a tautology; it affirms the necessity for the separation of the points, which is a fact of observa-

tion; but it is not apparent what can be the rôle of the intervening nerve fibres, since nothing produces an impression upon them. The theory of nerve fields is powerless to explain this.

The explanation which I propose to substitute for the preceding ones may be summed up in a few words. I assume that every point on our epidermis has a special way of feeling; the *quality* of the sensation varies with the region of the skin; for example, when the forehead, then the cheek, chin, neck and the nape of the neck are pressed by the finger, a different tactile sensation is produced every time. This variation always takes place in a continuous manner from one point to another; if we chose two points close together it might happen that the difference between the two sensations would be too slight to be perceived, and that the two sensations would behave practically as if they were identical. The distance at which the two sensations may be distinguished in consciousness is not uniform over the whole body, for the local quality of each sensation does not vary equally all over. This being admitted—and we shall shortly enumerate the arguments which prove our hypothesis—what will happen? By exciting two points on the skin with the compasses, we may produce at pleasure, according to the distance apart of the points and the region of the skin, two different sensations or two similar sensations; they will be different when the points on the skin are far enough apart for their difference of sensibility to be appreciable; they will be alike when the points selected are suf-

ficiently near to each other for their sensibilities to appear the same in kind.

Now, in the case of two different sensations, the subject will feel the two points distinctly; in the case of two similar sensations, these sensations will become fused into one, and the subject will feel only one point.

Weber's experiment would be explained, according to this hypothesis, by the fusion of similar sensations; it would be an illustration of the *law of fusion*. But what must be added to demonstrate the truth of this hypothesis? Two things must be proved:

First.—That the sensations produced by the two points of a pair of compasses are of different quality when the subject perceives the two points.

Second.—That the sensations produced by the two points of a pair of compasses are of the same quality when the subject perceives a single point.

Lotze, Wundt, Helmholtz and others in Germany have attributed a difference of sensibility to the different regions of the body. This is what is called the *theory of local signs*. We shall choose one, the most striking, from among the proofs of this theory: it is derived from the phenomenon of localization. When we touch a person on any part whatever of his body, he feels and at the same time he localizes the excitation. This knowledge of place is not innate; it is acquired. It is formed, in all probability, in the following manner: We have learned by experience that when we feel a certain tactile sensation, a pressure is produced on the arm; a

certain other sensation corresponds with an action on the toe, and so on. In the course of time we have connected a definite sensation with the sight of our arm, another with the sight of our toe, and finally each different sensation with the sight of a different point on our skin. When we come to press, prick or pinch our body, the sensation proper to the part affected awakens the ocular image of that part by the mere power of association. It is a mental law that when two sensations have been experienced in contiguity they adhere in such a way that the one presented suggests the other. In the present case the suggestion is effected so rapidly that the visual image of the part touched follows the tactile sensation immediately. Localization is nothing else. As regards the position of the point touched, it is given us by our muscular activity. This explanation of the genesis of the *sense of place* always assumes one thing: that two sensations of contact which are referred to two different parts of the body both possess a local sign which distinguishes them and prevents them from being confounded with each other. Suppose all our sensations of contact were absolutely uniform. A person pricked on the finger will not know whether it was on his finger or his toe, for if his toe had been pricked he would have experienced the same sensation. For one sensation of contact to become associated with the sight of the finger, and another with the sight of the toe, it is absolutely necessary that the two sensations be different; otherwise they will be confounded with each other, and the sensa-

tion whose seat is at the finger will be able to suggest indifferently the ocular image of quite another part of the body.

In short, localization implies distinct sensations. This fact puts us in a position to know when the two sensations produced by the compasses are similar or different. Are they susceptible to being localized in a distinct manner? Then they are different. Are they not susceptible of distinct localization? Then they are similar.

By making use of this criterion, we find that in every case in which the two sensations are felt double the subject can localize them, which proves that they are of different natures. For example, I press the two points of my compasses transversely on a person's forearm, the points being thirty-nine lines apart, the distance necessary for the subject to feel each point separately. Then I lift the two points up alternately, asking the person, whose eyes are shut, to inform me if it is the right or the left one he continues to feel. He replies correctly every time; he localizes exactly. This is plain proof that each of these sensations differs a little from the other. Thus in the case where the subject perceives two points, there are two different sensations, as is proved by the possibility of distinct localization.

Conversely, we have to investigate if it is possible for the subject to give a different localization to two sensations which, simultaneously produced, have the effect of a single sensation. We try experimentally how far apart we may put the two

points without their ceasing to be confounded with each other, and we mark with ink the points on the epidermis at which they are placed. It is always well not to go as far as the maximum distance, for it varies a little during the course of the investigation, merely by attention and exercise; it might therefore happen with the maximum distance that the two sensations, which were at first similar, became in a moment different, a condition of things which would disturb the experiment. After these preparations, we excite alternately the two points marked with ink, asking the subject to state, with his eyes shut, upon which one the instrument is placed. The subject does not succeed in this, or, if he tries to localize, he does so with alternate success and failure, which proves that he is guessing. This inability to localize the two sensations can depend upon only one cause, the similarity of the two sensations.

It is therefore true that the experiment with the compasses gives us an example of the fusion of two similar sensations. This is all that we wished to show.*

In the preceding experiment the sensations which are fused together are exactly, or almost exactly, alike, and the fusion resulting from their being brought together is *total.* Let us give an example of *partial* fusion. A partial fusion often exists in a series of sensations which succeed one another, and each of which resembles, in part only,

*For further details I may refer to my article on the *Fusion des sensations semblables* (*Revue philosophique*, September, 1880).

that which precedes and that which follows it. This is what occurs in the zoötrope, thaumatrope, phenakistoscope, *dedaleum*, cinematograph, etc. These scientific toys are designed to produce a series of impressions on the retina of the observer, representing the successive phases of any periodic movement, for example, a man who juggles with his head.

Each figure in the zoötrope, taken separately, differs very little from its neighbour on the right and on the left; their resemblance may be expressed by the following letters *abc*, *bcd*, *cde*, *def*, *cfg*, *fgh*, etc., which indicate the portion common to two successive impressions. When the toy is put in motion and its rotation is sufficiently rapid, the impressions become fused together by their common points and give us the illusion of a single person, always the same, who makes the movements.

The study of the mechanism of this illusion is the more interesting because it artificially reproduces what occurs every time that we perceive a body undergoing changes of form or position, for example, a trotting horse.*

We prefer to collect facts rather than linger over explanations which will come of their own accord. Let us confine ourselves to anticipating a possible objection by showing that the fusion of zoötropic images is effected in the brain and not, as one might believe, in the retina. This is proved, first of all, by the fact that the consecutive visual

*Clifford has, by extending the idea of the zoötrope, denied that the world can be continuous.

images which are produced in this fusion have a cerebral seat (see above, page 44). In the second place, there is the more direct proof that the fusion is not produced *en bloc*, but only between the similar portions of the images, which implies a power of analysis which is certainly wanting in the retina.

The fusion of similar images. — Images fuse together like sensations, a fact which is understood once their nature is known, for they are revived sensations. It often happens that a succession of images, partially similar, passes across the field of the mind, producing appearances of transformation comparable to those of the zoötrope. One of Mr. Galton's correspondents, the Rev. George Henslow, sees, every time he shuts his eyes and waits a short time, the clear image of some object. This object changes its form for as long as Mr. Henslow watches it. It is noticed, in studying the series of successive forms, that the passage from one to the other is supplied sometimes by relations of contiguity and sometimes by relations of resemblance. In one of these experiments the following images were seen: A cross-bow, an arrow, a person shooting the arrow, his hands alone being visible; a flight of arrows completely occupying the field of vision; falling stars; large flakes of snow; a landscape covered with a sheet of snow; a rectory with its walls and roof covered with snow; a spring morning, with a brilliant sun, and a bed of tulips; the disappearance of all the tulips with the exception of one; the single tulip becomes double; its petals fall off rapidly, there is nothing left but the

pistil; the pistil enlarges, and the stigmata change into three branching brown horns; a knob; the knob bends and becomes a stick; then a sort of pin passing through a metal plate, and so on. The experimenter has sometimes succeeded in completing what he calls a "visual cycle"—that is to say, returning to the original image and going through the same series of forms anew. These visions recall that of Goethe, in whose case the cycle was shorter. "When I closed my eyes and *depressed my head*," relates the German poet, "I could cause the image of a flower to appear in the middle of the field of vision; this flower did not for a moment retain its first form, but unfolded itself and developed from its interior new flowers, formed of coloured or sometimes green leaves. These flowers were not natural flowers, but of fantastic forms, although symmetrical as the rosettes of sculptors. I was unable to fix any one form, but the development of new flowers continued as long as I desired it, without any variation in the rapidity of the changes."

It is plain that the transformation of the imaginary object is produced by a succession of images. But it is important that the nature of this succession should be clearly understood. The images are not simply substituted one for another, the last to arrive expelling the preceding one; if things occurred thus, we would have distinct images replacing each other, and not a single image which is metamorphosed. It must be understood that each of the images is *fused* with the preceding one by virtue of

the common points which they offer, and that, besides, the two successive images co-exist during a very short instant. Thanks to these two conditions, the two images form a whole and give the appearance of a single image undergoing modification.

The hallucinations of the insane often present the same evolution of forms. Magnan relates that an alcoholic inebriate saw upon the wall cobwebs, ropes, nets with contracting meshes; in the middle of these meshes and strands, black balls appeared, which enlarged, became smaller, took the form of rats, cats, passed across the strands, leaped upon the bed and disappeared.* In rarer cases the metamorphosis requires years. A young girl who had become insane in consequence of an attempt to assassinate her, continually saw the fist and the arm of the individual who had attempted to kill her. Now, the disease following its course, the hallucination underwent a curious transformation. The image which was seen by the young girl became modified thus: Two eyes appeared on the fist of the assassin, his arm became excessively long, and finally the hallucinatory image changed into a serpent.† In other cases the outline of the hallucination remains constant, but the dimensions change. In an old observation by Beyle, a patient saw an ordinary cobweb, which grew to the point of filling the whole of his room and suffocating him. Dreams supply innumerable examples of

*Magnan, *De l'alcoolisme*, p. 56.

†Max Simon, *Le monde des rêves*, p. 118.

these kinds of transformation; sometimes two distinct persons are seen blending into one; or the same person changes his physical personality, etc. The dream is the true type of metamorphic hallucinations.*

We mention these morbid cases because the phenomenon which we are studying is therein magnified and more easily examined. But we also meet excellent examples of the fusion of images in the normal operations of life. According to Huxley, the formation of general ideas would be effected by the union, the fusion, the coalescence of several images of individual objects; and in order to express his thought better, the naturalist-philosopher makes use of an ingenious comparison, drawn from the *Composite Portraits* which we owe to Mr. Francis Galton's invention.† "This mental operation may be rendered comprehensible," says Huxley, speaking of the generalization of an image, "by considering what takes place in the formation of compound photographs—when the images of the faces of six sitters, for example, are each received on the same photographic plate, for a sixth of the time requisite to take one portrait. The final result is that all those points in which the six faces agree are brought out strongly, while all those in which they differ are left vague; and thus what may be termed a *generic* portrait of the six, in contradistinction to a

*J. Sully, *op. cit.*, p. 163; and Maury, *Sommeil et rêves*, p. 146. M. Delboeuf has compared the metamorphoses in dreams to *dissolving views*: "It is," he says, "as if we projected two pictures on the same screen, and at the same place, by means of two magic lanterns, and illuminated one while the other was being extinguished." (*Revue philos.*, June, 1880). This explanation confirms ours, it does not destroy it.

†Galton, *Inquiries into Human Faculty and its Development* (Appendix: *Generic Images*).

specific portrait of any one, is produced.* This beautiful invention has, it appears, already produced brilliant results. By combining in a single photograph five medals representing Cleopatra, which, far from giving an idea of the beauty of that celebrated queen, had a hideous appearance, a much more pleasant composite portrait was obtained. It is probable that the points of resemblance between the different likenesses were reinforced in this resultant, and that the points of difference remained unaccentuated (*flous*); so that we may reasonably maintain that the composite portrait has a better chance of being like the model than its components. Photographs of individuals belonging to the same classes have also been combined by this method, and thus certain types, as for example, the swindler type, have been obtained. This method will perhaps become useful to criminal anthropology in the future.

Huxley's comparison between these composite photographs and concepts has been accepted by many psychologists; it has been regarded as very probable that the generalization of an image is formed in the mind like the generic photograph on the sensitive plate, by the superposition of particular impressions. We may add a corroborative argument. M. Pouchet has remarked that the consecutive images of his microscopic preparations which, as we have already seen, sometimes appeared to him after a long interval, do not represent any preparation in particular, but are like the *mean*

*Huxley, *Hume* (*English Men of Letters Series*), p. 95.

of a series of preparations of the same kind. This fact tends to show that the generic image is the result of the coalescence of several particular impressions united into a single one.

However, it would be very unscientific to explain a mental operation by a comparison with a purely mechanical phenomenon, unless that comparison implicitly assumed the existence of a principle of fusion. The formation of generic images is explained by the principle of fusion; particular impressions, becoming fused together, form a generic image because their common parts are fused together and are brought out strongly, while the parts which differ remain separate and become vague.

The comparison between the generic image and the composite photograph is only accurate in so far as it illustrates this mental law; taken literally, it is not rigorously exact. If the eye of a man, says Galton, be put in the place of the object glass of the apparatus used in obtaining composite portraits, the image which would be formed in his brain would not be identical with the composite portrait. For, contrarily to the photographic effect, the physiological effect of an impression is not proportional to its duration or its frequency; we know that, according to Weber's law (a disputable law, whose fault is that it is too precise), the sensation varies as the logarithm of the stimulus; in order that the sensation may follow an arithmetical progression, the stimulus must follow a geometrical progression. We may also add the disturbing effect of attention,

of emotion, of preconceived ideas, and of a great number of other factors, which prevent the mind from fusing several images together with the exactness of a photographic plate.

We have given a sufficient number of examples to make it clearly understood in what the fusion of sensations and of images consists. It seems impossible that a phenomenon so easy of observation should have passed unnoticed. Among the authors who have alluded to it we may first of all mention Herbert Spencer. Defining a state of consciousness, this author says that it is "any portion of consciousness which occupies a place sufficiently large to give it a perceivable idividuality; which has its individuality marked off from adjacent portions of consciousness by *qualitative contrasts*, and which, when introspectively contemplated, appears to be *homogeneous*."* It follows from this definition that if the portions adjacent to the state considered are not *different*, they form part of the same state; but to say that is to implicitly recognize the principle of fusion. Later on Mr. Spencer adds: "The requisite to the existence of two feelings is some *difference*."† Therefore, if there is no difference, there is a single state, that is to say a fusion of the two states into one. These few quotations show us that Mr. Spencer has observed, at least in passing, the phenomenon of fusion, but without comprehending its importance.

Mr. Bain has made a few remarks on the same phenomenon. "In the case of perfect identity

*Spencer, *Principles of Psychology*, Vol. I, p. 164.
†*Op. cit.*, Vol. I, p. 167.

between a present and a past impression, the past is recovered and fused with the present, instantaneously and surely. So quick and unfaltering is the process that we lose sight of it altogether; we are scarcely made aware of the existence of an associating link of similarity in the chain of sequence. When I look at the full moon, I am instantly impressed with the state arising from all my former impressions of her disc added together."* The description refers to a case which we shall consider presently: the fusion of a sensation with an image. Elsewhere the same author speaks of cases in which we are cognizant of an identity without being able to say what the identical thing is, as for example when a portrait gives us the impression that we have seen the original, without our being capable of saying what the original is. The identity has struck our mind, but the restoration is not made. Everybody knows that very singular feeling of "already seen." Mr. Bain explains it by the absence of recollection of the different parts of the object identified. In fact, in order that the mind may perceive the resemblance between two images, they must differ a little; if they do not, they become added together and form a single image. Lotze expresses the same idea with a *lourdeur* which is quite German: "We should know nothing whatever of this fact, the reproduction of a former *a* by the present A, if the two were simply present, with no distinction between them, at the same time. To know the present A

*Bain, *The Senses and the Intellect*, p. 466.

as repetition of the former *a*, we must be able to distinguish the two; and we do this because not only does the repeated A bring with it the former one which is its precise counterpart, but this former one also brings with it the ideas *c d*, which are associated with it but not with the present A, and thereby testifies that it has been an object of our perception on some former occasion, but under different circumstances."*

This fusion has also been described by Wundt under the names of *assimilation* and *simultaneous association*. "The perception which results from the actual excitation of any one of the senses combines with a representation reproduced by memory." Finally, it is only right to recall that Ampère had, long before Wundt, described and analyzed the phenomenon, which he called *concretion*. It was Ampère, M. Pilon tells us in a luminous article on the *Formation des idées abstraites et générales*,† it was Ampére who first showed that the images of former sensations modify our actual sensations to the point of making us see more than we see, and hear more than we hear. A man speaks to us in a language which is quite unknown to us; why do we not distinguish what he utters, while if he speaks in a familiar language, we clearly perceive every word he pronounces? It is, replied Ampère, by reason of the *concretion* which takes place between the present sensations of sounds and the images of those same sounds which we have

**Metaphysik*, Book III, Ch. II.

†*Critique philosophique*, Vol. I, No. 3. (New series.)

often heard. "If the words which are sung in the Italian opera," he said again, "are not pronounced strongly, the listener seated at the back of the theatre receives the impression of vowels and musical modulations only; but he does not hear, and therefore does not recognize, the words pronounced. If he then opens the book of words of the opera, he will, by following them with his eyes, hear quite distinctly these same utterances which he was unable to catch a moment before. What has happened to him is this. The sight of the characters before his eyes, forming not only the visual sensation of the moment, but images of sensations of the same kind which he has experienced in learning to read Italian, the sight of the written words awakens in him the sonorous and acoustic images of the words pronounced, and the images of the sounds reinforcing in his mind the too feeble impressions received from the stage, the result is that he hears distinctly."*

Here our quotations cease. They suffice to show that our study of the fusion of similar states of consciousness is altogether without originality, for this phenomenon has been perceived by a number of authors.

While not wishing to exhaust this subject, we desire to say a few words on its physiological aspect. We have this moment seen the rôle resemblance plays in the sphere of sensations and images: it suggests and fuses. The first effect is better known than the second. However, we

*Philosophie des deux Ampère, p. 37.

believe that we have placed the fusion of similar sensations and also of similar images beyond doubt. We even infer, by means of induction, that this phenomenon occurs every time that we perceive a resemblance, from the insignificant act which makes us recognize a friend, to the flash of genius which discerns an identity between the most remote phenomena, such as the fall of a stone and the force which urges the moon towards our globe.

It remains to discover whether there exists a physiological phenomenon which might be considered as the basis of this double property of resemblance.

We may assume as exceedingly probable that two states of consciousness which resemble each other totally or in part, must in general involve the entering into activity of the same nerve elements, cells and fibres, totally or in part—that is to say, to the same degree. This hypothesis appears to us to be a necessary consequence of the principle of cerebral localizations, according to which all impressions of the same kind affect the same part of the brain. But it is by no means necessary that the rule should be made absolute; we are inclined to admit that there exist in the brain non-differentiated territories, where even similar impressions may affect distinct points. After having made this restriction in our hypothesis, we may mention some of the numerous facts which militate in its favour.

We all know the involuntary mistakes which make us pronounce one word instead of another. Lewes records that he was one day relating a visit

to the epileptic hospital, and, intending to name the friend, Dr. Bastian, who accompanied him, he said, "Dr. Brinton," then immediately corrected this with "Dr. Bridges;" this also was rejected, and Dr. Bastian was pronounced. "I was," he says, "under no confusion whatever as to the persons, but, having imperfectly adjusted the group of muscles necessary for the articulation of the one name, the one element which was common to that group and to the others, namely B, served to recall all three." M. Ribot, from whom we borrow the preceding quotation,* has made an analogous observation on mistakes in writing. Wishing to write "*doit de bonnes,*" he wrote "*donne;*" wishing to write "*ne pas faire une part,*" he wrote "*ne part faire.*" We may again remark that in pathological paraphrasias and paragraphias the confusion is often produced also by an identity of letters or by consonance.

All this is explained, as the authors just quoted observe, by supposing that the same nerve elements enter into different combinations, and that for example the names of Bastian, Bridges and Brinton correspond to complexus of cells which have a common element, the element which corresponds to B. Thus the psychical quality of the resemblance would find its anatomical counterpart in an identity of seat.

A phenomenon analogous to paraphrasia may be produced in oneself at will by setting oneself the problem of finding a proper name which one knows but which is not before the mind at the

Diseases of Memory, p. 29. (Appleton, N. Y.)

time. Experimental psychology may thus be studied without a laboratory. One day I tried to recall to mind the name of one of my friends to whom I wished to write a letter; this friend is called M. Truchy. I did not succeed in finding his name again immediately. I passed through the following intermediate steps, which I noted down accordingly, for they afford a beautiful example of paraphrasia:

Morn*y*
Mo*uchy*
S*uchy*
C*ruchy*
Truchy

At each effort of memory I gained one or two correct letters. The course of the experiment seems to show clearly that the letters common to the series of names involve the excitation of the same nerve elements.*

We may therefore accept as a very likely hypothesis that the resemblance between two states of consciousness generally has its physiological counterpart in an identity of seat of the nerve process. This hypothesis has moreover been already pointed out by Mr. Spencer. Every image, he says, tends to aggregate with like images by virtue of the *identity of their cerebral seat.*

We may now make our deductions. First of all, it becomes possible to explain the suggestive action of resemblance physiologically. That every

*Many other proofs might be mentioned. For example, repetition strengthens the association of two images, or of two movements; how could that be explained without admitting that the same nerve elements receive impressions at every repetition? etc.

state of consciousness has the property of reviving those similar to it, is due to the complexus of cells which correspond to the excitative state and to the state excited having common points, by which the nerve wave flows away from the first group of cells into the second. It is equally easy to understand the fusion of two similar states into one, since they have a numerically single nerve element as their basis.

This hypothesis has a second advantage; it explains how a resemblance between ideas is effectual even when it is not recognized by the mind.

Psychologists are asked what may be properly understood by a resemblance which would not be perceived. Resemblance, it has been said, implies a mental comparison, and when this comparison is absent, when there is no consciousness, the resemblance can no longer exist (Penjon). The true solution of the difficulty seems to us to be as follows: It is true that there is no resemblance without the consciousness of the resemblance, for the two things are in reality only one. But consciousness is only an epiphenomenon, superadded to cerebral activity, and capable of disappearing without the corresponding nerve process being altered. Two similar images succeed each other in our mind. It matters little whether we did or did not notice their resemblance, for, being similar, they will put a common cell element in vibration. This identity of seat will be sufficient to produce all the results which are produced by a resemblance which is recognized and judged by a conscious comparison.

Thus it happens that an image suggests one similar to it, without consciousness participating in the act. Is it not, moreover, in this way that suggestion by resemblance operates? Like automatically evokes like; when the act is accomplished, reflexion intervenes to give an account of what has happened, and it is only then that we discover the existence of a resemblance in the chain of ideas. M. Pilon has developed the same idea with his usual lucidity. "We must distinguish," he says, "between association by resemblance and the perception of the resemblance. It is not by means of the relation of resemblance perceived between two ideas that one of these ideas may suggest the other; for this perception of resemblance implies that the two ideas are present to the mind, and consequently that the association is already formed. To say that resemblance is an element in association is simply to say that one idea has the property of suggesting another idea which the mind then recognizes, by means of the faculty of perceiving relations, as similar to the first." (*Op. cit.*, p. 194.)

Another deduction of the same kind as the preceding one is that the formation of general ideas must take place without the intervention of the self, in the same manner as suggestion by similarity and for the same reasons, by the sole virtue of the images raised; or, in more accurate terms, by the effect of the identity of seat of the particular impressions. Images have the property of organizing themselves into general images, as they have the property of suggesting similar images. Thus

we possess general ideas which are produced in us entirely by themselves, such as the general idea of a chair, a knife, etc.

It will perhaps be thought that these views of cerebral physiology, although they may be hypothetical, have the advantage of according with the prepossession of many psychologists who seek the explanation of mental operations in the properties of the nervous system. Here we have the opportunity of showing what this prevalent opinion is worth, it being more correct in appearance than in reality. Let us admit, for an instant, that it is not merely probable, but absolutely demonstrated that two similar states of consciousness have *a single nerve element* in the brain as their basis, and that this unity of seat explains the two effects of resemblance: suggestion and fusion. Does any one by chance believe that we have here, in the properties of the nervous system, a true explanation of the properties of resemblance? That would be a singular illusion. For this is no explanation whatever, but simply a transposition into physiological terms of the phenomenon which is claimed as explained. What is this *single element* which we state to be the basis of resemblance? How can we understand its unity if we have not the idea of number, of plurality, and is this idea not at least more complex than that of resemblance? "*Nous voilà au rouet*," as Montaigne said.

The truth is that we can only know exterior things by referring them to the laws of our mind, and that consequently the study of one of these

objects, a brain for example, can give us no information as to the *forms of our thought*, for it always implies them. Those who maintain the contrary are guilty of a *petitio principii*.*

II.

Thus extended and modified, the law of resemblance will enable us to understand the genesis of external perception. Let us study this genesis in itself, without any preconceived ideas, without considering that the phenomenon is a result of reasoning. True to our method, let us appeal to pathology, for morbid cases often let us perceive the secret of the normal state.

Hypnagogic hallucinations afford a wide field of observations and experiments. M. Maury hit upon the clever idea of making experiments on his own person, so as to estimate to what extent external impressions intervened in dreams. In the evening, when he began to fall asleep in his arm-chair, he asked a person placed by his side to produce sensations in him without forewarning him, then to awaken him when he had already had time to dream a dream. The results obtained by this method really belong to the study of external perception, for what is a dream when produced under these conditions? It is a cerebral reaction following an impression of the senses—and this definition applies

*The same observations may be advanced in the case of those authors who, like Hamilton, Brochard, James, Rabier, etc., try, without introducing physiology, to explain the resemblance between two states of consciousness by the *common* elements in the two states, or by a partial *identity* of their elements. This pretended attempt at simplification simplifies nothing at all, for it replaces the idea of resemblance by the ideas of identity and of unity, which are merely its derivatives. We repeat that resemblance is a single, ultimate and irreducible idea. (Cf. Brochard, *De la loi de similarité*, *Revue philosophique*, March, 1880.)

to perception. We shall presently see that the observer's dreams may be compared to artificial illusions of the senses. Here are the facts:

His lips and the end of his nose are tickled with a feather; he dreams that he is undergoing a horrible torture, that a mask of wax is being placed on his face, then when it is being pulled off, the skin on his lips, nose and face is torn. A pair of tongs is rubbed with steel scissors a short distance from his ear; he dreams that he hears the sound of bells; this sound of bells soon becomes the tocsin; he thinks he is back in the days of June, 1848. He is made to breathe eau de cologne; he dreams that he is in a perfumer's shop, and the idea of perfume arouses that of the Orient; he is at Jean Farina's shop in Cairo. He is made to smell a burning match; he dreams that he is at sea (the wind was then blowing on the windows) and that the *Sainte-Barbe* is pitching. He is pinched lightly on the neck; he dreams that a blister is being placed there, which awakens the recollection of a doctor who attended him in his infancy. A warm iron is brought near to his face; he dreams of *chauffeurs;* the idea of these *chauffeurs* soon brings that of the Duchess d'Abrantes, whom he supposes in his dream to have taken him as her secretary. He had formerly read some details about *chauffeurs* in the *Memoirs* of that clever woman, etc.*

These experiments show that the *quality* of the sensory impression has an influence on the nature

*Maury, *Sommeil et rêves*, p. 127.

of the dream, for the trace of the generating impression is found again in the images of fantasy.

But some other observations by the same author may be here given which are still more to the point; they concern dreams produced by subjective sensations. One night, M. Maury, when half awake, sees a luminous spark (a subjective sensation of the sight); he immediately transforms it, yielding already to the desire for sleep, into a lighted street lamp. Then before his eyes appears the Rue Hautefeuille, lit by night, as he had many a time seen it when he was living in it, thirty years before. The following is another example from the same author: "When I suffer from retinal congestion, coloured patches and luminous circles shape themselves upon my eye-lid. Well, in the short instants during which imaginary images foretell the coming of sleep, I have often found that the luminous image which was due to the excitation of the optic nerve was in some way altered under the eyes of my imagination, and became transformed into a countenance whose bright features represented those of a more or less imaginary person. It was possible for me to follow the metamorphoses effected by my mind on this original nervous impression, for several seconds, and I again perceived upon the forehead and cheeks of these heads, red, blue or green colour, a luminous brightness which shone before my closed eyes, previous to the commencement of the hypnagogic hallucination."*

In many similar cases it may be found that the

Op. cit., p. 59.

imaginary image of the dream is preceded by phenomena of excitation, which are localized, perhaps wrongly, in the retina. The subject who is falling asleep begins by perceiving gleams, confused masses strewn with little coloured points, striae and filaments. The appearance of these amorphous sensations precedes the seeing of definite forms. M. Maury has expressed the idea that the dream hallucination arises from these "subjective spectres," and is derived from them by a kind of transformation. In this case there is, as M. Maury has correctly said, a *metamorphosis* of images; and this metamorphosis recalls that of the zoötrope.

But in making this comparison we either say nothing at all, or we affirm a certain fact. We have seen how the change-effects produced by the zoötrope are explained; there is a series of impressions which follow each other at very short intervals; these impressions are not identical, no more are they absolutely different; each resembles in part the one preceding and the one following it. By means of this partial identity each impression blends with its neighbour and forms with it a single whole. It is this fusion of successive impressions which gives the spectator the illusion of a single impression. We may suppose, in order to explain the genesis of the hypnagogic dream, that the principle of fusion operates not only between two sensations and between two images, but also between a sensation and an image.

This supposition enables us to analyze the beginning of a hypnagogic hallucination in the fol-

lowing manner. A luminous sensation, a spark for example, crosses the field of vision; this sensation recalls, by the effect of resemblance, the mental image of an object which also presents a luminous point, for example the image of a lighted street lamp. Let us denote the initial sensation by the letter A, and the complex image of a lighted street lamp by the letters A B C D E F G H, etc.; the letter A in the second group represents the luminous point in the lamp—that is to say, the element which is common to the image of the lamp and the sensation of a spark. But, further, the two elements represented by A fuse together and form a single element in such a way that the image evoked blends with the sensation, and the spark is transformed into a street lamp; then this last image recalls the entire image of the street by the association of contiguity.

We find this same fusion of sensations with images in a large number of toxic hallucinations. One woman who had just taken some hashish in order to experience the blissful delirium which that substance produces in the Orientals, "saw her brother's portrait, which was above the piano, become animated and display a forked pig-tail, entirely black," etc. A moment afterward she went towards the door of a neighbouring room which was not lit. "Then," she says, "I experienced a frightful thing; I was choked and suffocated; I fell into an immense bottomless pit, the well at Bicêtre. Like a drowning man who clutches for safety at a frail straw which he sees escaping him, so I tried

to catch on to the stones which surrounded the pit; but they fell with me into that bottomless abyss." Her cries were heard, and she was brought back to the lighted part, and, her ideas changing with the new impressions, she thought she was at the opera ball, and she struck herself against a stool, which she took to be a masquerader, prone on the floor, and dancing in an unseemly fashion; then she walked in the midst of a country of lanterns, which phantasmagoria was produced by the flame of the coals which burned in the fireplace.* When this sensory delirium is closely studied, its development may be readily followed. Its origin is in the sensations of every kind produced by the external world in the midst of which the patient moves; the impression of the senses calls up the images which resemble it; these images appear, accumulate, become transformed under the influence of the toxic agent, become separated more and more from their point of origin, and finally create an entirely imaginary external world, which a new impulse of real sensations will again come to modify. But at the first moment of the evolution of the delirium, there is always at least a shade of resemblance between the exterior object and the images which it evokes, as is seen in the hallucination of the well at Bicêtre, produced by the dark room, and it is this resemblance which causes the fusion.

Let us pass to the case of alcoholic delirium. We know that the visual hallucinations which

*Moreau (de Tours), *Du hachisch et de l'aliénation mentale*, p. 14.

accompany it consist of terrifying visions of little animals, cats, rats, insects, spiders, human heads separated from their trunk, etc. These hallucinations are not formed at once; according to the evidence of the best observers, the visions are preceded by elementary troubles of a purely sensory character. The patient sees black points or luminous spots, which are animated with rapid movement; these are the subjective sensations from which the hallucination is formed, and which the brain of the alcoholic inebriate ere long transforms, according as the delirium becomes more accentuated. "In some cases," says Magnan, "the patient at first sees a dark, blackish spot, with a vague outline, then with distinct boundaries with prolongations which become legs and head, so as to form an animal, a rat, a cat, or a man." Does this phenomenon not recall the zoötropic metamorphoses in a striking fashion? Is it not quite naturally explained by a fusion of sensations and images?

The same explanation may be readily adapted to all cases in which our brain causes the sensations which it receives to undergo a transformation. One of the most interesting examples of such transformations is afforded us by what might be called *imaginary perceptions*. Everybody must have noticed that when the environment is favourable one can at will picture to oneself the presence of a certain body, and perceive it as if it actually existed. We distinguish a great many forms in clouds, in rocks, in the confused masses of dim or distant objects, in the flames of a fire, in the inequalities of a wall, or in

the lines, holes and irregularities of a wooden table. It seems that Leonardo da Vinci recommended his pupils, when they were looking for a subject for a picture, to carefully study the appearance of surfaces of wood; in fact, at the end of a few minutes of attention, it does not take long to see certain animal forms, human heads, and sometimes whole scenes picturesquely arranged, shape themselves in the midst of the confused lines. On this matter I have a fairly extensive experience; if I gaze attentively at a sheet of white paper, I always discover some figure on it; I can even copy it, and the drawings which I obtain by this process are generally very superior to those which I am able to produce by imagination alone, although in reality they are not worth very much; but this is a purely relative matter. I have often remarked that the figure is not formed right away, but slowly and by degrees, like a piece of decoration which is built up of successive pieces. The important thing is to obtain the first form; if it is fairly vivid, it will not be long in completing itself, the edifice being noiselessly constructed on that first stone.

It would be exceedingly interesting to study this imaginative side of our nature. The germ of a theory of invention, more genuine than all those which we have so far obtained, might perhaps indeed be found therein. However that may be, it is important for us to observe that the mind, in these perceptions, works on the fortuitous resemblances which it discovers in an object; it is through these points of resemblance that the imaginary

image is evoked and becomes blended with the sensible impression. At the same time, which is a curious thing, the mind systematically neglects all the characteristics of the external object which do not harmonize with this fiction.

Imaginary perceptions belong to the same family as illusions of the senses; they might be defined as voluntary illusions. They are the dramas of which we are at once author and spectator. Involuntary illusions supply us with similar facts. Every time that an illusion lends itself to analysis, it is perceived that the false exteriorized image, which, properly speaking, constitutes the illusion, in some way resembles that which gave it birth. For example, when, by reason of distance or obscurity, we take one person for another, or allow ourselves to be deceived by an imperfect resemblance, we commit an error of identification; in other words, the first image awakened by the external sensations resembles them and is blended with them. This, moreover, is confirmed by hypnotic experiments. Move your hand before the eyes of a somnambulist, imitating the movement of wings with your fingers; he immediately sees a bird and tries to catch it. Imitate a reptile's movement with your hand on the ground, and he sees a serpent. The general rule is that the subject sees all the objects whose appearance is simulated.

We pass by an insensible transition from the illusion, or false perception, to true perception. Let us see if every act of perception likewise takes its rise in an act of identification.

I take hold of a book on a table; I lift it, open it, turn over its leaves, read it, and close it. All these acts have aroused a large number of impressions of touch, form, weight, temperature, resistance and movements in me, which are united together and associated with the visual impressions which I felt at the same time. Let us now suppose that I leave my room, and return to it after some minutes' absence. The book is still in the same place; if I look at it, the visual impression which I experience awakens in my memory the images of sensations of all kinds which I received when handling it a short time before. In short, images of touch, of the muscular and other senses proceed to combine with the visual sensation. Perception therefore takes place.

But how does it happen that this new visual sensation can awaken, under an ideal form, these impressions formerly received by the hand? There is in this case no bond of resemblance, nor even any bond of contiguity, for the actual sensation of sight is absolutely new, and could not become associated with impressions received by the hand several minutes before. There is one reply, and only one, to this question; it is that the actual aspect of the book *resembles* in part or in totality the former aspect, the recollection of which persists in my mind. From my preceding experience there survives an ocular image of the book, associated with impressions from the hand. The appearance of the book as actually seen is fused with this visual recollection, which in its turn brings the train of tactile

and muscular recollections to which it is bound into the field of consciousness.

According to this interpretation, the series of states of consciousness which succeed each other in perception is as follows:

The actual vision of the book (A) excites in our thought, by the force of similarity, the ocular image of the same book (B) which is due to a former vision, and this second state of consciousness in its turn excites, by the force of contiguity, the group of tactile and muscular impressions (C). It is the state of consciousness (B) which enables the first state to excite the third; so I propose to call it the *intermediate state of consciousness*, in order to express its function.

The curious fact is that this image (B), the visual recollection of the book, does not make its appearance, in spite of the importance of the part it plays. When we look at the book, we do not have, simultaneously with this vision, the distinct recollection of a former vision. Yet this recollection constitutes an indispensable part of the operation, for without it perception would be impossible; it is in a manner "invisible and present;" it is fused with the visual sensation of the moment, and becomes one with it,* so that this sensation is found directly associated with the group of tactile and muscular images.

Let us represent the course of the phenomenon graphically.

*We assume, for the sake of simplicity, that the actual vision of the book and the visual recollection of the same object completely resemble each other, and that the fusion is total; if the resemblance is only partial, the fusion also is partial.

The perception of the book has the effect of uniting a visual sensation to a group of tactile and muscular images. The formation of this association constitutes the conclusion of the perceptive reasoning. This mental synthesis may be expressed by the formula

$$A-C$$

in which A represents the actual vision of the book, C the group of muscular and tactile images —that is to say, the fact inferred, and the sign — the bond of association which unites these two terms.*

The psychological question which now arises is, as we have shown above, to explain the formation of this association. Now, we say that the actual vision of the object begins by reminding us of a former vision by means of the resemblance between these two states. This again may be represented symbolically in the following manner:

$$A=B$$

In this formula A continues to represent the actual vision of the book placed before our eyes, B represents the recollection of a former vision of that same book—that is to say, its visual image—and the sign = indicates the resemblance between the sensation and the image. This identification is, in

*We employ algebraic signs merely in order to represent in a graphic manner the properties of the images which coöperate in an act of reasoning. It must be added that in no way do we place ourselves at the point of view of English logicians such as De Morgan, Boole, and Stanley Jevons, who also make use of these signs, but for the purpose of putting the problem of logic in the form of an equation, and of solving it by processes more or less analogous to those of algebra. Consult on this subject the interesting work of Louis Liard, *Les logiciens anglais contemporains.*)

our opinion, the first part, the first act of external perception.

In this case there is not only a recollection, a calling up of the image B, but this image, when once evoked, becomes fused with the sensation A, like the two sensations of the points of the compasses in Weber's experiment. There is nothing astonishing in this result if we recollect that an image is almost a sensation. We have devoted a chapter to demonstrating that fact. We may therefore indicate this fusion in the following manner, which has the advantage of appealing to the eye:

$$[A=B]$$

In this new formula the brackets express the fusion of the sensation and the image.

Here the first act of perception finishes and the second begins. We have assumed in our example that former experiences had cemented an association between the vision of the book and the exceedingly diverse sensations which this object produces when we take it up, open it and read it, sensations the recollection of which has been designated by the letter C. This may be represented thus:

$$B-C$$

a formula in which B still represents the former vision of the book, C the experiences of active touch, and the sign — the pre-formed association between these two images.

We therefore say that, through the fact of the fusion of A and B—that is to say, in consequence

of the fusion of the actual vision with the visual recollection of the object—C is associated directly with A, or, in other words, the idea of the invisible attributes of the object is directly associated in our mind with its visual aspect. Finally, we arrive at this last formula, which is self-explanatory:

$$[A=B]-C$$

To sum up, the whole operation may be analyzed thus: An association by resemblance, the purpose of which is to *introduce* an association by contiguity. As the latter is the end, it diverts the attention from the former, which is the means.

It would be easy to simplify the description of this operation by showing that it may be reduced to the partial assimilation of two images. In fact, perception is produced by the partial fusion of the ocular sensation which the object actually produces upon us with the complete recollection of the same object, or of a similar object, which lives in our memory. This assimilation of two impressions is the biological property from which reasoning springs.

We began by offering this mechanism of perception as a hypothesis. But if this explanation be compared with all the pathological facts which have been cited, it will be recognized that the hypothesis very nearly attains to the rank of theory. We have seen that in all the morbid perceptions which lend themselves to analysis, the phenomenon begins with an act of identification—that is to say, by a *fusion of the excitative sensation with the first image which*

it evokes. We may recall, among the most typical cases, the sleeper who, seeing a spark, transforms it into a lighted street-lamp, and sees a street lit at night appearing before him; the alcoholic inebriate who, seeing black points moving in his field of vision, transforms them into little black beasts with lengthening legs; the wide-awake person who, by fixing his attention on the confused lines on a table, finishes by seeing fixed forms come out of them; and, finally, the individual affected by an illusion of the senses, who confounds a stranger with a friend, letting himself be deceived by a rough resemblance of size, of figure, or of dress. Always and everywhere external perception, whether it be exact, whether it be false (illusion), or whether it be insane (hallucination), takes its rise in a fusion between the sensations of the external world and the images which these sensations cause to spring up in the mind.

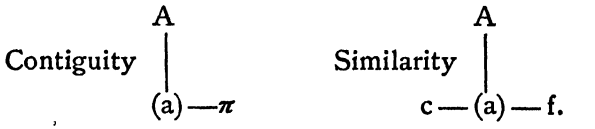
The only difference is that in false and pathological perceptions a shade of resemblance is sufficient to produce suggestion, while in correct perception we only take account of an ensemble of resemblances, and even a shade of difference is enough to prevent suggestion. Helmholtz has remarked that in the stereoscopic arrangement the presence of a badly-projected shadow destroys the illusion. But we are obliged, in the interests of clearness, to put aside these details. All that we retain of the preceding discussion is the fact that perception takes its rise in identification.

Moreover, how could it be otherwise? When

we perceive an external object, we receive sensations which are always new and distinct from all those which have preceded them. How then could those new sensations evoke past, former states, such as images, if not by the effect of resemblance? Resemblance is the only bond which could unite states separated by time. Let us state this problem in an *a priori* form, employing the formulae which we have already made use of. On the one hand, B is associated with C. On the other hand, A resembles B. How can A become associated with C, if not through the medium of B?

Before going further, we wish to show that these complex phenomena in which similarity and contiguity are combined have already been noticed by psychologists, although they did not understand their significance. Two passages may be read in this connection, one from James Mill (*Analysis of the Phenomena of the Human Mind*, Vol. I, p. 111, *et seq.*), and the other from Mr. Bain (*eod. loc.*, p. 464, *et seq.*). We shall quote only Mr. Sully, who remarks, in his book, entitled *Outlines of Psychology*, that the two laws of contiguity and similarity are at once distinct and inseparable. "Each mode of reproduction may be said to involve the coöperation, in different proportions, or with different degrees of distinctness, of two elements, a link of similarity or identity and a link of contiguity. Thus when a person's name calls up the image of his face, it is because the present sound is automatically identified with previously heard sounds. So, too, revival by similarity commonly involves con-

tiguity as shown above. But in ordinary cases what we call revival by similarity involves the calling up of concomitant circumstances." The author symbolizes the relation between the two laws as follows:



In the first case the process of identification between A and (a) is automatic or unconscious, and the revived concomitants (π) are thought of as quite distinct from that which revives them; whereas in the second case the identification is the important step in the process, and the concomitants (c and f) are not distinctly separated from the identified element (a). We have only to compare this plan with our own to recognize the identity of the two: First of all we see therein the fusion of one state of consciousness with a second similar state, then the suggestion of a third state which was associated with the second by contiguity.

But what is yet more important to notice is that the process of perception which we have described is, according to Stuart Mill, Mr. Bain and Mr. Sully, a general process, which is realized every time that an association of ideas comes into play—that is to say, at every instant in our lives. Now, as we shall presently proceed to demonstrate the logical value of this process, which constitutes true reasoning, we shall consider reasoning, not as an accidental fact, but as the constant element in our

lives, the fabric of all our thoughts. Thus, we shall come to accept as a demonstrated truth that apparent paradox of Wundt's: *The mind might be defined as a thing which reasons.*

III.

The phenomena which we are at present studying are so important that we are willing to protract the examination. Perception, we have said, is an operation in three terms; we have seen how many proofs lend support to this proposition. But we wish to continue the demonstration to its conclusion by quoting examples of perceptions in which the distinct existence of these three terms may be directly recognized by inspection alone. This occurs whenever perception, in evolving and becoming complicated, tends to become confused with conscious and voluntary reasonings.

Let us take a simple example, which we shall afterwards try to complicate. In what does the process of reading a written word consist? At first sight it is merely bringing an association of contiguity between a graphic sign and an idea into operation. When the graphic sign is very clear, like a printed letter, the suggestion of the image follows the seeing of the sign immediately; the operation appears to be in two terms, like the majority of our ordinary perceptions. For example, the image of a house appears vaguely when we read the word "*house.*" But let us complicate the operation a little; let us try to retard it in order to grasp it better in detail, and a supplementary term is im-

mediately detached. We take, in place of a printed word, a word written by the hand and almost illegible. Then we perceive that the sight of the characters is not enough to make them understood; it is necessary, in addition, to recognize them, to state that this disfigured letter is an *a*, this other a *c*, and so on. But how is this recognition possible, if not by a comparison between the altered character and the recollection of the normal character? We decide that this letter is an *a* by ascertaining that it more or less *resembles* the letter *a* which we know. Eliminate this recollection, this intermediate state of consciousness, and the operation becomes impossible.

There are numerous examples of the same kind. One more may be given. There are some diagnoses which are made at a distance, so far as they are easy; a neuro-pathologist has often merely to see a sufferer from ataxia walking, or a paralytic (Parkinson's disease) moving in the street in order to recognize their disease. The mere sight of a prominent symptom evokes the name of the disease, and the representation of all the other symptoms which belong to the same affection. But most frequently the sight and even the methodical examination of the patients is not enough; the physician must gather his recollections together in order to make the diagnosis. What does he do then? He compares the case he has before him with analogous cases which have already occurred. Trousseau even said that in this work of comparison he distinctly remembered patients whom he had formerly

seen in the hospital while he was a student; he pictured their appearance, and even, he says, the number of their bed. This conscious reversion to previous and similar cases brings the intermediate state of consciousness prominently into view. This state is always apparent when the similarity does not operate in a sure and infallible manner.

We may therefore affirm that three images succeed each other in the perception of an external object. We have still to show the importance of this analysis. It is exact, it may be said, but what is the use of it? It describes for describing's sake; it supplies no information as to the mechanism of reasoning; after having engaged in a minute psychological dissection, we know no more of the matter than we did before.

Our aim is to show briefly, and above all as clearly as possible, the significance of the results obtained. We are convinced that we are now able to give an exact theory of the mechanism of reasoning; in fact, thanks to this supposition that in every perception there exists an *intermediate state of consciousness* (B), serving as the connecting link between the impression of the senses (A) and the inferred images (C), everything becomes clear; this supposition is like the word which, interpolated in a mutilated text, reveals its meaning. We shall presently see that we can recognize, in the account of perception reconstituted in this manner, all the parts which go to form a regular act of reasoning.

First of all, the act of perception becomes a transition from the known to the unknown by

means of a resemblance, and it will be remembered that this is a rough, though exact, definition of reasoning. The known fact is the sensation which we actually experience, for example, the visual sensation of a book placed on a table. The unknown fact is the nature of the object which gives us this visual sensation. We obtain this desired idea through the suggestion of a recollection—the image of a book; now, the transition from the sensation to the image, from the known fact to the unknown fact, is afforded us by the resemblance of the visual object to the object with which we identify it.

It will perhaps be said that reasoning is something more than this consecution of images; it is a judgment, it is the formation of a new belief. Therefore it is not sufficient to explain how the complete and detailed image of the book can be called forth on account of an elementary sensation of sight or of touch; it would still be necessary to give an account of this new belief which enables us to affirm that "this is a book." The suggestion of a fact is one thing, and the judgment which accepts it as true is another. For example, we shall not explain the reasoning which makes us say that Paul is mortal, if we merely show how the idea of the death of this individual comes to our mind; as we may yet state how this idea determines our conviction. Such is the objection which certain readers will not fail to offer. Let us try to reply to it.

Belief, conviction and assent are among those vague, liquescent and ill-defined phenomena which are

numerous in psychology; they could with difficulty be made the subject of methodical study. But psychologists have adopted a bias; they have remarked that belief generally resulted from a relation between images. When two facts have often occurred at the same time or in immediate succession, the corresponding images have a tendency to become connected in our mind, and, further, we have a tendency to believe that the phenomena, the ideas of which are associated in our mind, are likewise associated in reality. (See p. 79.) This stated, it is clear that a theory will explain the formation of a new belief if it explains not only the suggestion of the idea to be affirmed, but the association, the organization of this idea with others. Let us repeat our argument, so as to make it clearer. We admit that it is not sufficient to say, in order to explain our reasoned conviction that a certain man must die, how we obtain the idea of the death of a man; but the moment we explain how this idea of death *becomes associated* with that of the individual in question, so as to produce the belief that he is mortal, we have attained our end, and demonstrated that which required demonstration.

Well, has this demonstration been furnished? Has the preceding analysis explained how, apart from all experience, merely by an operation of mental laws, an association can be formed between two images? This was, it will be remembered, one of the conditions which we had urged (p. 94) against every explanation of reasoning—this condition seems to us to be fulfilled. We have seen the

reason why the detailed image of the book is combined with the visual sensation of the moment; it is because these two impressions have points of resemblance which weld them together. Thus are explained all the syntheses of our sensations and of our recollections.

But that is not all; a reasoned conclusion does not merely include an adoption of a new truth. This truth also presents that particular character of being a logical consequence of a truth already admitted. In psychological terms the association of images which is established by reasoning takes place through the medium of preëxisting associations which are called premisses. To reason is to establish associations on the model of other associations which are already formed. (See p. 95.) It remains to show that our thesis on the mechanism of perception gives an account of this latter character of reasoning. To this end, we must establish a new parallel between external perception and the syllogism.

In the first place, it will be observed that perception is an operation in three terms, A, B, C. The first term (A) represents the actual vision of the object, the second (B) its former vision, and the third (C) the inferred properties. The syllogism is also an operation in three terms; in the example which we analyzed before, these terms are *Socrates*, *man* and *mortal*.

Again, in the syllogism the mean term enters into the major and the minor and disappears in the conclusion, although it is preparatory to it. It is

the term "man." Reasoning, as Boole remarks, is the elimination of a mean term in a system of three terms. This mean term, we say, is preparatory to the conclusion; for if Socrates were not a man, he would not be mortal. Similarly in perception, the term B, the visual recollection of the object, is a true mean term; on the one hand, it vanishes when we reach the conclusion, for it blends with the actual vision (A); on the other hand, it is preparatory to the conclusion, for if the actual aspect of the object did not resemble the former aspect already seen (B), we would not be able to recognize it.

But the parallel may be pushed much further. It is possible to divide the act of perception into three slices, as is done with the syllogism—that is to say, into three parts which correspond to the three verbal propositions of an act of logical reasoning.

Let us begin by translating the familiar syllogism, which we have used so often, into psychological language. Let us take the major premiss first:

All men are mortal.

This proposition states, according to a logician's analysis,* that the attributes connoted by "man" never exist unless conjoined with the attribute called mortality, so that wherever the first attribute is found we may be sure of the existence of the second. It is a relation between two facts. Psychologically, the proposition has another meaning; it means that there exists in our mind an associa-

*John Stuart Mill, *Logic*, p. 122.

tion between two groups of images, one group of abstract images representing man, and one group of generic images representing death. We understand by the word association that these two images are produced simultaneously or in immediate succession in our mind. We say again that the two images are *contiguous*. Consequently we shall call our major proposition a proposition of contiguity. It is to our past experience, or to the testimony of others, that we owe that association; it is given, acquired, considered as corect, at the moment when we perform the act of reasoning. It is upon it that our conclusion will depend.

The minor premiss of the reasoning

Socrates is a man,

is of another nature. It signifies from the logical point of view that there is a perfect resemblance, an identity, between certain attributes of Socrates (colour, form, size, internal structure) and the attributes of humanity. That is what the proposition *signifies;* now, as a distinct question, what *is it* from the psychological point of view? It is an act of assimilation between the image of certain attributes of Socrates and the generic image of humanity. Here the mind seizes a resemblance between two groups of images, and the proposition which expresses this internal act may be called a proposition of resemblance.

The conclusion

Socrates is mortal,

contains the truth discovered by deduction. Considered from the objective point of view, it signifies

that there exists a relation of coexistence between the individual called Socrates and the attributes of mortality, or, in other words, that Socrates possesses these attributes. Psychologically, this proposition indicates that a relation of contiguity has been established in our mind between the image of Socrates and the image of mortality.

To sum up, the preceding reasoning may be divided into three propositions: (1) A proposition of coexistence, the major premiss; (2) a proposition of resemblance, the minor premiss; (3) a proposition of coexistence, the conclusion.*

Now, let us put the propositions of the syllogism, on the one hand, opposite the symbolic formulae which we employed in our analysis of perception, on the other hand:

Major premiss: *All men are mortal*	B—C
Minor premiss: *Socrates is a man*	A=B
Conclusion: *Socrates is mortal*	(A=B)—C

The major premiss of our syllogism is, we have said, a proposition of coexistence; it signifies that the generic image of man is associated in our mind with the abstract image of mortality. Similarly, in the formula B—C we find an association of images indicated; for this formula means that the former

*According to Mill (*op. cit.*, p. 123), the principle involved in every inference strikingly resembles the axioms of mathematics. It is that "things which coexist with the same thing, coexist with one another." Thus: Socrates coexists with man.—Mortality coexists with man.—Therefore Socrates and mortality coexist with one another. But there is an error in this analysis; in reality the reasoning is not composed of three propositions of coexistence. The minor premiss is a proposition of resemblance. To say that Socrates is a man means that he resembles men whom we know. Mill himself remarks this (p. 383). So we ought rather to say:—Socrates resembles man—man coexists with mortality—Socrates coexists with mortality. If it were desired that a principle should be deduced from this operation at all costs, we would propose the following: "A thing which resembles another thing communicates to it the property which it has of coexisting with a third."

vision of the book (B) is associated with the image of its tangible qualities (C). Therefore, on both sides there is the same association of contiguity.

The minor premiss of our syllogism expresses a resemblance between the mental representation of Socrates and that of the attributes connoted by the word humanity. In the formula A=B, there is also an identification between the actual vision of the book (A) and the recollection of a former vision (B) —that is to say, between the sensation and the image of one and the same thing. Therefore, on both sides there is the same association of resemblance.

Finally, the conclusion of our syllogism indicates that an association of contiguity exists between the image of Socrates and the image of death. In the formula (A=B)—C, we also see an association of contiguity become formed between the vision of the book and the idea of its tangible attributes. Therefore, there is, once more on both sides, the same association of contiguity.

It would be superfluous to dwell further on this matter. Perception is evidently composed of the same parts as formal reasoning. But the direct study of formal reasoning cannot lead to a theory of that operation, for the states of consciousness which are its subject are too complicated for one to be able to observe the law according to which they are connected. When I say, "All men are mortal; Socrates is a man, therefore he is mortal," what takes place in my mind? Of that I know nothing accurately. I seem to perceive a train of confused

images. In any case I am unable to understand how these images are connected and disposed in reasoning. I am, to employ one of Wundt's comparisons, like a physicist who wished to study the vibrations of a pendulum by looking at them through a keyhole, or like an astronomer who, to study the sky, took up his residence in a cellar.

The study of simple perceptions reveals to us the law we seek; it shows us that sensations and images become organized by virtue of the two laws of similarity and of contiguity. The study of morbid cases, dreams, hallucinations, etc., throws full light upon the subject.

Finally, our theory satisfies the three conditions which we had laid down; it introduces only the known laws of the association of images; it explains how an association is established between two images by the operation of mental laws alone; finally, it explains how that association is formed on the model of former associations.

All the preceding discussion may be reduced to a single formula, which will serve us as a definition:

Reasoning is the establishment of an association between two states of consciousness, by means of an intermediate state of consciousness which resembles the first state, which is associated with the second, and which, by fusing itself with the first, associates it with the second.

It is often convenient to characterize a theory in a word. Our theory of reasoning is a theory of substitution. We see in it the main term (A) *sub-*

stituting itself for the middle term (B)—that is to say, one image taking the place of another and partially identical image.*

*We have had the pleasure of meeting a very analogous theory in an article signed by a very keen and original psychologist, Mr. William James. After having defined similarity as the association of wholes, or aggregates by virtue of their common points, he observes that the process of association by similarity closely resembles that of reasoning properly so called. Reasoning, says he again, consists in a substitution of parts of different wholes. In a certain sense it would be not at all too paradoxical to say that confusion and reasoning are two species of the same genus. We identify the thing in question with a part of a certain other whole. In this common process, if the operation be exact, there is reasoning; if not there is confusion.—We quote from M. Renouvier's analysis. (*Critique philosophique*, 1879, p. 370 et seq.)

CHAPTER V.

CONCLUSION.

I

WE consider it useful to distinguish carefully between the results of our analysis and the conclusions which we shall presently draw therefrom. We believe it will be readily admitted that in every perception there exists a succession of three images, the first of which fuses with the second, which in its turn suggests the third. The existence of these three images and their coördination appears to be now and heretofore well established. These are facts which psychologists of any school may admit without fear of compromising the theories that are dear to them.

But the conclusions, the interpretations which these facts suggest, will not, in all probability, meet with so ready an assent, for I shall presently have to touch upon questions on which many minds are already decided. It is only right to add that these interpretations are much less solidly established than their point of departure.

Under cover of these reservations I shall try to show that the *theory of three images* is applicable to reasonings of every kind, and therefore constitutes a general theory of reasoning. We might already affirm, *a priori*, the legitimacy of this

investigation; for unless it be maintained that higher reasoning has been created in its entirety, it must certainly be admitted that it is the termination of an ascending evolution, and we must indicate from what lower form it proceeds.

The reader already knows that there is no decided difference between perception and logical reasoning; the two operations are both reasonings, transitions from the known to the unknown. The analogy is so close that we were able to compare perception with formal reasoning, and to show that perception contains all the essential elements of a peripatetic syllogism. (See p. 88.) In short, perception and logical reasoning are only the two extremes of a long series of phenomena, and when we place ourselves in the middle of the series we find inferences which belong to both at the same time. (See p. 70.) Further, we have shown that a kind of filial relationship exists between perception and the reasonings of conscious logic. Thus, when we make systematized anæsthesia, which has been developed in a patient relatively to a certain person, gradually disappear, the thing which appears first of all is the perception of the person as species; and it is only afterwards, by a kind of ascending evolution, that the recognition of the person as individual takes place; now, we know that recognition is a complex operation which touches closely upon reasoning properly so called. All these reasons lead to the belief that perceptive reasoning and logical reasoning imply the same mechanism. (See p. 77.)

Let us now examine the principal objections which may be made to this argument.

One of the characteristics which distinguish logical reasoning from perception is that objects constitute the material of logical reasoning and sensations the material of perceptive reasoning. There follows from this a second difference, drawn from the existence of language; language being formed in order to name objects and not sensations, lends its support to logical reasoning and refuses it to perception. But let us neglect this second difference, which is secondary and derivative, so as to devote our attention to the first. Let us be exact. In what, from the psychical point of view, do the terms of logical reasonings consist? Some consist of general and abstract ideas; the others are recollections of facts, or recollections of particular objects. All of them are the residues of former perceptions; they proceed from them more or less directly, but they all do proceed from them; they are all percepts.

Up to the present we have considered the percept as a synthesis of sensations and images, or rather as a sort of microcosm; here the percept becomes unity. We may compare it to a chemical radicle, which, although composed of atoms of different bodies, reacts like a simple body. The percept of a person or of a fact, in which we saw the result of automatic reasoning, becomes a term in complicated reasonings; so that we might say of these latter operations that therein we reason on reasonings.

This stated, the question is to know whether

logical reasoning is constructed with percepts as the percept is constructed with sensations. No good reason can be alleged against this unity of mental composition; we do not see why percepts, which are groups of images, should have other properties than isolated images and sensations; and we do not see why the percepts of logical reasoning should not associate themselves according to the same processes as the images and sensations in automatic reasoning.

To make ourselves better understood, let us appeal to an analogy. When we wish to prove that a visual recollection produces the same chromatic effects as the actual vision, we experiment with the most simple visual recollection, the representation of a colour; we have seen elsewhere (p. 40) that the idea of that colour, of red, for example, produces a consecutive green image. The experiment only succeeds by placing one's self under such conditions of simplicity; no consecutive coloured sensation would be obtained by mentally representing to one's self a complicated object, such as a country landscape or the appearance of a market. Nevertheless, we certainly do not hesitate to transfer to the complex image the phenomenon observed in the simple image of a colour, and to make this phenomenon a general property of images. We believe that the generalization is quite as legitimate in the case of reasoning; we claim that in this case again, what can scarcely be ascertained directly save for isolated images should be transferred to complex images;

we claim that it should be admitted that the terms of logical reasoning are connected in accordance with the same laws as the images of perceptive reasoning, because these terms are groups of images which should have the same properties as isolated images.

But there is a still more decisive reason for believing that logical reasoning is constructed on the same model as perception. Our analysis of perception took the study of the syllogism as its point of departure; it was proposed as an aim to find in perception again all the parts of which formal reasoning is composed; this method led us to discover three terms and three propositions in perception, comparable in all respects to the terms and the propositions of the syllogism. From that dissection resulted the theory of three images. Why should this theory not be applicable with entire justice to the syllogism, since it comes from it?

We shall conclude with some reflections on the order in which the syllogistic propositions are arranged.

Mr. Spencer has directed a certain number of critcisms against the syllogism in this connection, some of which appear to us to be well founded. "When I say," he says,*

"*All crystals have planes of cleavage;*

"*This is a crystal;*

"*Therefore, this has a plane of cleavage;*

and when it is asserted that this describes the mental process by which I reached the conclusion,

*Op. cit., Vol. II, p. 97.

there arises the question, What induced me to think of 'all crystals'? Did the concept 'all crystals' come into my mind by a happy accident the moment before I was about to draw an inference respecting a particular crystal? No one will assert such an absurdity. It must have been, then, that a consciousness of the particular crystal identified by me as such was antecedent to my conception of 'all crystals.'" That is, one of the elements of the minor premiss has suggested one of the general elements of the major premiss. This objection seems to us very reasonable, as it leads us to transpose the premisses in the following way:

This is a crystal;

All crystals have planes of cleavage;

This has a plane of cleavage.

But we are quite unable to follow Mr. Spencer in his objections to this new arrangement of the premisses. Why, he asks, have I been led by the idea of this particular crystal to think of all crystals, and not of quite another class? Why? we may answer. It is in consequence of a relation of resemblance; it is because "this" resembles a crystal, crystals which we know, and consequently the class of crystals. Why, says Mr. Spencer again, when I think of crystals do I think of their planes of cleavage, and not of their angles, their axes, or of any other of their properties? I think of their planes of cleavage by reason of a pre-established relation of coexistence between crystals and planes of cleavage. I would have been able to think of any other attribute, it is true; in that case the

conclusion would have been different, and instead of saying that this crystal has a plane of cleavage, I would have attributed to it a certain other property. That is all. Is a thing impossible because it would have been possible otherwise?

It is therefore necessary in every syllogism to transpose the premisses, to place the minor before the major, and to say: "This is a crystal; all crystals have planes of cleavage, this has a plane of cleavage;" or again, "Socrates is a man; all men are mortal, therefore Socrates is mortal."

We then discover a striking resemblance between perceptive reasoning and logical reasoning. In the two cases, the operation begins in an association of resemblance. The new arrangement of the syllogistic propositions is therefore quite conformable to the course which the mind follows in reasoning, since it reproduces the course of perceptive reasoning, that which constitutes the true "living" reasoning, while the reasonings of logical treatises are dead reasonings, dissected by the logicians.*

*Thus we believe that, in all kinds of reasoning, the psychical labour consists essentially of a fusion of images. But this conclusion in no way prevents us from recognising that the human mind passed over an immense interval on the day when it passed from perceptive and unconscious reasoning, which is common to the majority of animals, to logical, conscious, really scientific reasonings, which are only accessible to a very small number of individuals. The superiority of these latter reasonings depends upon an infinity of causes; they imply the power of seizing, beneath apparent contrasts, real similitudes (for example, the assimilation of the mechanical force of the wind with that of a waterfall, of the flower with a transformed leaf, of the skull with a vertebra, of the lightning with the electric spark, of respiration with combustion, etc.); they imply a comparison between the various parts of reasoning, which are all brought before the mind, and which permit it to judge if the conclusion is justified by its premisses; finally, they have the result not only of demonstrating, but of explaining, by bringing the inferred fact back under a more general law; in this lies the superiority of reasoning over observation, of the deductive sciences over the experimental sciences, of the geometry of Euclid over tachimetry.

II.

Let us admit that reasoning is essentially one, that the simplest of inferences is, like the highest of generalizations, produced by a fusion and a grouping of images. From this general definition of reasoning we may deduce its utility, its function, its sphere and its limits. If it be recollected that images are fragments, residues of former sensations; that they spring from the same place as former sensations have been received, in the sensory centres of the cerebral surface layers; it will be understood that the purpose of these images, in grouping themselves in reasonings, according to the laws of their affinity, is to replace the absent sensations.

Such is therefore the function of reasoning; it enlarges the sphere of our sensibility, and extends it to all objects which our senses cannot know directly. Thus understood, reasoning is a *supplementary sense*, which has the advantage of being freed from those strict conditions of time and space, the two enemies of human knowledge. Reasoning is in turn the eye which sees, the hand which touches and the ear which hears.

We find examples of these different functions in the study of perceptions.

When, during the night, we cross a room which we know, the impressions of touch which we feel excite visual images which guide us among the furniture and prevent our striking ourselves and stumbling. The mechanism of this suggestion is a

perception of touch—that is to say, a reasoning. Reasoning therefore enables us in a manner to *see*, by means of the visual image, the object which we touch in the darkness. And this internal vision is exceptionally developed in somnambulists, who usually walk with their eyes closed and can avoid obstacles of every kind by their hyperæsthetic sense of touch. It is probable that if the somnambulist does not see by his eyes, he sees by reasoning. It is reasoning which, from the depths of the darkness, guides him by means of an internal light, formed by visual images. Thus we understand a multitude of improbable feats, how, for example, a certain somnambulist can write a page of manuscript, read it over and correct it exactly, without the coöperation of sight.

We are all acquainted with the thoroughly authentic story of an abbé who wrote sermons during his fits of natural somnambulism.* One day a white sheet was placed on the page of manuscript which he had just finished, and he re-read it on this white sheet, making erasures and corrections here and there which coincided exactly with the text below. In this case he had a most exact visual image of the written page, and he exteriorized that image on the sheet of paper, thus replacing sight by reasoning. These extreme cases give us the key to the normal state.

It is more difficult to demonstrate directly that logical reasoning is like a supplementary sense, and

*This observation is cited by Bersot, *Mesmer et le magnétisme animal.* 5th edition, p. 247.

that its purpose is to give us an internal vision* which protracts the external vision. In the syllogism the fact affirmed by the conclusion is too complex, too abstract, for the knowledge of it to appear comparable to a sensation. However, many authors have maintained an analogous thesis; Schopenhauer said that the axioms of geometry are felt. We shall no longer have any doubt on this point, if we carefully observe what happens with hysterical subjects, those species of *voyantes* who very often materialize the conclusions of their reasonings and make hallucinations out of them.

One day we suggest to W——, who is in the state of somnambulism, that she should make a gesture of contempt at a bust of Gall placed on a neighbouring table.† When she awakes she makes the gesture indicated, and seeking to explain the motive of this suggested act, which is for her spontaneous and free, she says: "That bust is disgusting." This is a reasoned conclusion; but note that this conclusion takes the form of a hallucination; the patient *sees* the bust under a disgusting aspect. M. Féré has related this second example to me: We give, one day, to another patient the hallucination of M. Féré, and we make her believe that she is fighting him; during this imaginary combat the patient strikes his temple a vigorous blow with her fist, which stretches him on the ground. On the morrow the awakened patient sees M. Féré enter-

*Here we take, for the sake of greater clearness, vision in place of all the senses, that is to say the species for the genus.

†The majority of the facts which we describe have been elucidated by us in the course of researches pursued in common with Dr. Féré at the Salpêtrière hospital.

ing the ward, and she perceives that he carries a black-and-blue mark on his temple. This mark was produced by the imaginary blow which she had given him on the previous evening. Here again the conclusion of the reasoning culminates in vision. The patient performed the following unconscious reasoning: I have given him an extremely violent blow with my fist on his temple; therefore he must carry the mark of it. Hence the hallucination of an ecchymosis. Upon coming out of a phase of profound lethargy which has lasted five minutes at the most, a patient imagines that she has slept for several hours. We answer that it is two o'clock in the afternoon (it was really nine o'clock in the morning). The patient immediately feels the most acute hunger, and begs us to let her go and dine. Here again there is reasoning (it is late, therefore I am hungry) which produces as its conclusion a kind of organic hallucination, the hallucination of hunger.

The preceding examples are unpublished; the following are some others which have already been published, but the phenomenon has not yet been studied from the point of view at which we place ourselves. M. Richet suggests to Miss C——, when she is in a trance, that she is going on board a packet boat, and that she is leaving for New York; soon the rolling of the boat makes itself felt, the woman becomes pale, and, throwing her head back, she has an attack of real nausea. This hallucination is produced by the logical development which the subject causes the suggestion of a sea voyage to undergo; this sickness is a conclusion from un-

conscious reasoning: I am on a packet-boat, therefore it rolls, therefore I am sick. M. Richet suggests to one of his friends that he is making a balloon ascent; the subject soon sees a huge shining ball in the distance; it is the earth, a sight which he suggests to himself, and which is again a deduction from the original suggestion. When he prepares to descend, M. Richet suggests that a piece of string is suspended down to the earth and that the subject should allow himself to slide down, holding on to the string with his hand. During this dangerous excursion the subject stopped suddenly, saying that the rope burned his hands. This is a fresh deduction which takes the hallucinatory form.

The authors who comment upon facts of this kind see in them merely a manifestation of the association of ideas. It would be, they say, by association of ideas that the patient who believes herself to be on a steamer experiences nausea, etc. When they have pronounced that great word "association," they think they have said everything. That is a mistake. Although there are hallucinations which are scarcely anything but recollections resuscitated under a sensible form, and in which the mind of the patient lets itself be guided by pre-established and completely formed associations, this is not a general rule. In other hallucinations it is quite the contrary; the patient imagines, creates, invents an entire sensation, an object, an event, a scene or a picture, which is as new for him as for us, the witnesses. Far from confining himself to associations already formed, he makes

new ones, like that hallucinated subject who, rising in a balloon, sees the earth at his feet, although up to that day he had never made an aerostatic ascent. Now, this establishing of new associations, this construction of images according to a new plan, is really reasoning. But it is clear that between reasoning and recollection there are all possible transitions, for reasoning is an application of a recollection to a datum which is new but similar; and that which predominates in the operation is the reproduction of the recollection, or its new application, as the case may be.

Here are some other facts which call for the same reflections. One of our patients, transformed by suggestion into a priest, sees himself, upon awakening, dressed in a cassock which smells badly. A patient of M. Richet's, transformed into the Archbishop of Paris, spontaneously sees the President of the Republic, presents his New Year compliments to him, and hears the President replying in a low voice, "*eau bénite de cour.*" Another, transformed into a general, sees horses and aides-de-camp surrounding him, gives orders, reprimands, uses the telescope, etc. The curious thing is that when the subject is intelligent and imaginative, the suggestion which is directed towards him produces, not an isolated hallucination, but numerous hallucinations which form a picture. I may refer, in this connection, to the examples mentioned by M. Paul Richer (hallucinations of a dinner in the country, of a fête, of an open-air ball, etc.)* In these examples we

*Op. cit., passim.

often seize, on the wing, the logical exercise of the mind which draws every possible deduction from the theme imposed upon it. Nothing is better suited to show that the purpose of reasoning is to create a kind of *logical vision*, so much the more striking as under these circumstances, logical—or in other words, hallucinatory—vision surpasses actual vision in intensity.

The same phenomenon is frequently met with in mental alienation, when the insane person draws from a delirious conception a conclusion which assumes the hallucinatory form. Everybody knows the story of the man who, believing himself to be a king, took his rags for a royal mantle. A less-known case is that of a poor woman who, having one evening received, in a hallucination, a visit from her husband, had thereafter the hallucination of pregnancy. In this example one of the two hallucinations forms the premiss, and the second is the conclusion, and each conclusion becomes a hallucination.

In our opinion, the hypnotic experiments which we have just described give a most beautiful demonstration of a phenomenon which is doubtful and almost altogether elusive in the normal state.

We are inclined to believe that ordinary reasonings culminate in a similar but less intense vision. We throw a stone into a pond. The stone, after having produced noisy splashes on the surface of the water, falls to the bottom, while around the point where it fell there forms a series of waves. Thence we infer by reasoning that another stone

thrown into the same pond, or into any mass of water, will produce the same effect on it. (Bain.) But in what does this conclusion consist? At the moment when, just before flinging the second stone, I infer the effect which it is going to produce, what passes in my mind? Is it not an internal vision of the water, of the noisy splashes, and of those concentric waves which will be formed around the disturbed point? So the purpose of every reasoned conclusion appears to me to be to make us *see*, by the mind's eye, the object or the fact which the conclusion affirms. The person who reasons, meditates in order to behold within himself, in a sort of magic lantern, the images which pass and the pictures which are formed. Reasoning produces a kind of logical vision which fills the gaps in actual vision; it constructs a new universe in our mind on the model of the large. In short, such is the aim of knowledge: to know, to understand, to explain, to know the why and the how of things, all this culminates in an act of vision. The highest science is epitomized in these simple words: *to see*.

Memory, which preserves the impressions of the senses, reproduces them at the necessary moment, and localizes them in their places in the picture of the past, might justly be called, like reasoning, a supplementary sense; more exactly, memory is a vision of the past, while reasoning is, in general, a prevision—that is to say, a vision of the future.

These conclusions are confirmed by the previous experiments on the consecutive image, which lead

us to see in the visual centre a retina whose every point is represented in the peripheral retina. The expression "the mind's eye" ceases to be a metaphor, and the field of the mind is as if counterdrawn from the visual field. In fact, while experimenting on the *transferred* consecutive image, we see that this image, which, like a recollection, is cerebral, has definite dimensions, height and depth, a right side and a left side, and a position in the field of vision, properties which prove to be common to all the images of the mind, and render the relation between the image and the sensation still more intimate.

III.

Three images which succeed each other, the first evoking the second by resemblance, and the second suggesting the third by contiguity—that is reasoning. Submit any reasoning to analysis, and you will find nothing else at the bottom of the crucible. But it would be an error to believe that this process belongs specially to reasoning. Far from it. We meet it in all intellectual operations; it is the single theme upon which nature has embroidered the infinite variations of our thought.

The two well-known laws of the association of ideas are at the basis of psychology. They are, according to John Stuart Mill, Mr. Bain and Mr. Sully, blended together in so intimate a fashion that neither of them can ever act alone. Let us consider a case of similarity properly so called, a portrait recalling the original; in order that the two

similar images may not be confounded the one with the other, the second must present features which are slightly different; and how will these differential characteristics be recalled? By contiguity. Here we recognize our three images and our two relations of resemblance and of contiguity. In order that a relation of resemblance may be perceived, it must be followed by a relation of contiguity. Let us then examine a case of contiguity. What is necessary, asks Mr. Bain, in order that the sight of a river should recall its name to us? It is necessary that the actual impression made by the river restores, by virtue of similarity, the former impression of the river to which the former impression of the name was contiguous. Suppose that this revival of the old idea of the river does not take place upon the new presentation, then the bond of contiguity will not have an opportunity to enter into play.

In this case we again find our three images and our two relations. In order that a relation of contiguity may become known, it must be introduced by a relation of resemblance.

How does it happen that these ideal recollections are not reasonings, although they have their structure? To tell the truth, I do not in the least know. Perhaps we ought to appeal to what Lewes called the *attitude of the mind;* in a simple association of ideas we only interest ourselves in the hint of a new image; in reasoning, on the contrary, we take more account of the association which this new image contracts with the preceding one.

The formation of a general idea presents the same phenomenon of *isomerism;* we know that it arises from the union of several particular images which are welded together by their common portions; the total operation is therefore composed of an association of resemblance followed by an association of contiguity; it is the same familiar process. But here we find, between the general idea and reasoning, a logical affinity which explains this unity of composition; the general idea is a reasoning in embryo; to generalize any object is to affirm something in addition to the result of a single experience. The general idea of a tree contains more elements than the vision of an isolated tree; it contains an implicit conclusion.

All these phenomena are like the first outlines of reasoning. There are others, much more complex, which show the same mental composition. In order not to lose ourselves in too lengthy developments of our subject, we shall remain within the limits of the study of external perception.

So far, we have admitted that every perception results from a reasoning. This proposition is only true in general. In reality, many other acts may take the form of a perception—that is to say, manifest themselves directly after an impression of the senses. We may find in perception—first, an act of recollection; second, an act of imagination.

First.—There is no well-defined distinction between a perception-recollection and a perception-reasoning. "To the psychologist," says Mr. Sully, "it comes to very much the same thing whether,

for example, on a visit to Switzerland, our minds are occupied in *perceiving* the distance of a mountain or in *remembering* some pleasant excursion which we made to it on a former visit. In both cases there is a reinstatement of the past, a reproduction of earlier experience, a process of adding to a present impression a product of imagination—taking this word in its widest sense. In both cases the same laws of reproduction or association are illustrated; that is to say, an association of resemblance followed by an association of contiguity." Further on the author adds a remark which proves how frequent this phenomenon is. "And our state of mind in recognizing an object or person is commonly an alternation between these two acts of separating the mnemonic image from the percept and so recalling or recollecting the past, and fusing the image and the percept in what is specifically marked off as recognition."*

In what respect does a recollection differ from a reasoning? This is difficult to determine. We grasp the analogies between these two acts much more easily than their differences. All that the most attentive observation teaches us is that sometimes the suggested image is projected and localized in the panorama of the past, of which it appears to be a fragment, and sometimes it is referred to a present object, and throws off its character of oldness, so as to appear actual.

Second.—We have already spoken of imaginary perceptions. These are by no means rare facts,

*Op. cit., p. 235.

mere idle recreations; we necessarily see in them one of the forms of that desire for agreeable illusions which appears to be inveterate in us, for we meet it in the adult man, in the manifestations of art, in children, in their games (hide-and-seek, sham fighting, the doll, etc.), and even among young animals, in their mimic combats. Analysis shows that these voluntary illusions are constructed according to the same processes as correct perceptions; an association of resemblance followed by an association of contiguity. As to their distinctive characters, they are only to be found in the *attitude of the self* which accompanies sensory perception. The mind knows that it has to deal with an illusion; it does not take it seriously. One understands that it would be extremely difficult to analyze so complex a psychical state.

And now, how are we to explain this unity of composition among intellectual acts which have such different duties to perform? We believe that it is necessary to introduce the theory of evolution here. It seems to us probable that all psychical phenomena, so varied when we take them in the adult civilized man, have sprung from a common stock, and that they owe to that their unity of composition. But what can really be, in the three facts which we are comparing, the primitive fact to which the two others may be referred. It is that which is most necessary to the animial in its struggle for existence: reasoning.

In fact, reasoning is, as we have said, a supplementary sense, freed from the conditions of time

and space. We have by means of reasoning the sensation of external objects before they come into contact with our organism, which permits us to know in advance what conduct we must adopt; whether it concerns the animal in pursuit of food, in quest of the female, or in the interests of defence, reasoning, and perceptive reasoning in particular, is the basis of a preadaptation of the individual to its environment.

Memory, as a vision into the past, offers less utility than reasoning; we have more frequent need to look before than behind; it is a kind of intellectual refinement to contemplate the things of the past as past, and without making them serve in the explanation of present facts. Therefore it seems to us probable that memory is not a primitive, but a superadded fact; it has sprung from reasoning at a time when the struggle for existence became less imperious.

The same may be said of imagination, as a faculty of creating assemblages of images which do not correspond to any external reality. This faculty must belong to an advanced stage of development, for it is not directly useful in adaptation. Before taking pleasure in fictions, it was necessary to think of food, reproduction and defence. Therefore we must connect imagination with reasoning; it is reasoning deviated from its end, falsified, creating chimeras which we do not seek to rectify, because they please us; thus a statue is a fiction of which we like to be the dupe.

To sum up, all forms of mental activity are

reducible to a single one—reasoning. The psychical life is a continual conclusion. *The mind*, as Wundt says, *is a thing which reasons*.

IV.

The preceding theory explains reasoning by the properties of images and sensations, and by these properties alone. It introduces nothing else; therefore the expression "I reason," which is employed so often, is, taken literally, to a certain extent wrong. A collection of facts of consciousness—the self is nothing else—can have no action whatever on one fact of consciousness in particular. It is quite as incorrect to say that judgment is the act by which the mind compares. It is as if we said that chemical combination was the act by which chemistry unites two bodies. Just as the combination of the bodies results directly from their properties, so mental combinations, and reasoning in particular, result directly from the properties of images.

We may here repeat what M. Ribot has said of the voluntary act:* "The 'I will,'" he has remarked, "testifies to a condition, but does not produce it. The volition that subjective psychologists have so often observed, analyzed and commented upon, . . . is not the cause of anything. The acts and movements which follow it result directly from the tendencies, feelings, images and ideas which have become coördinated in the form of a choice. It is from this group that all the efficacy comes." The accuracy of this point of view

*_Diseases of the Will_ (Open Court Pub. Co., Chicago), p. 133.

is still more apparent, if that were possible, in the sphere of reasoning. The idea which we form of reasoning, the attributing of this operation to our self, to our personality, is a superadded phenomenon, and not an essential part of the operation. The "I reason" is not a cause, it is an effect. It is wanting in the child, in ignorant persons and in the millions of people who have never studied psychology. They have never tried to give an account of the fact that they reason, and of how they set about to reason. They are indifferent in the matter; they are content to reason without considering how they do it.

The *intransigeants* of psychology, those who push everything to extremes, have maintained that we must say, *It reasons in my brain*, as we say, *It thunders in the sky*. These expressions are not only ridiculous, they are inaccurate, which is worse. The formation of a self, as the centre and subject of all psychical phenomena, is not a matter of convention; it is a natural phenomenon, which is realized in every man. We must not therefore eliminate it. M. Richet has observed that in experiments on hypnotic suggestion, we may abolish and metamorphose the personality of the subject without for all that suppressing his *self*, which proves that the two things are distinct. When we transform the subject into a soldier, a dancer, a child, a bishop, or a goat, he adopts the language and the gestures of these different rôles, but he does not cease to say "I" in speaking of his sensations and of his acts, to have a *self*—that is to say, *a kind of point of*

insertion for all the sensitive and motor impressions which take place within him. (Richet, *La personnalité et la mémoire dans le somnambulisme, Revue philosophique*, March, 1883.)

So far nothing has been said of the principle or postulate which should be implied, according to many thinkers, in every kind of reasoning, and would justify the passage from the known to the unknown. The study of these principles holds an important place in treatises on logic. For example, the postulate of every induction would be the *uniformity of the course of nature*. In fact, it is said, in order to believe that what has been produced in a particular case will be reproduced in all similar cases, it is necessary to believe previously that "there are such things in nature as parallel cases; that what happens once, will, under a sufficient degree of similarity of circumstances, happen again, and not only again, but always."*

It was long ago answered that the uniformity of the laws of nature was not taught us by a supernatural revelation; it is a very complex piece of knowledge, which is wanting in the majority of men, and which, among those who possess it, is formed late, by a slow accumulation of partial inductions. To postulate the result of a particular induction, which is neither constant, nor elementary, nor primitive, as the foundation of our inductions would therefore be to reason in a circle.

The real foundation of reasoning must be sought in the psychical law which governs it. The

*John Stuart Mill, *Logic*, Book III, Chap. III.

organization of our intelligence is so arranged that when the premisses of a reasoning are stated, the conclusion results from them with the necessity of a reflex action. In other words, we reason because we have in our brain a machine for reasoning. The legitimacy of our inferences has not a rational basis; it is not proved, for every demonstration presupposes the legitimacy of the reasoning. This is a common sense truth.

Let us be more precise; in reasoning, the primary rôle belongs to the images; it is the images which arrange themselves, in reasoning, by virtue of the properties which they manifest when they are brought before the mind; it is they which spontaneously form, to our internal sight, the picture of the external world.

This conception is directly derived from the facts which fill this book. We have shown that similarity is a property of images, and we have said with M. Pilon that we must distinguish between the action of resemblance and the perception of resemblance. (See p. 127.) From this important distinction it follows that the suggestion of similar images is a primary fact of automatism; that the union and fusion of similar images into a generic image is a second fact of automatism; and that the organization of similar images into reasoning is a third fact of automatism. In all these cases the self only intervenes when the work is finished. Just as "the resemblance between two images is only perceived after their suggestion" (Pilon), so the

reasoning which they form in becoming organized is only perceived after its formation.

If it were necessary to make use of a comparison in order to describe the mechanism of reasoning, we would mention those flowers which are formed during frost on the window panes of rooms. Let us thaw them with our breath and then observe the regelation of the liquid layer. While crystallization is taking place round a first crystal "you notice one feature which is perfectly unalterable, and that is, angular magnitude. The spiculae branch from the trunk, and from these branches others shoot; but the angles enclosed by the spiculae are unalterable."* Just as these crystallizations are produced by the forces inherent in each of the molecules, so reasoning is produced by the properties inherent in each of the images; just as crystallization, in its oddest eccentricities, always observes a certain angular value, so reasoning, true, false or insane, always obeys the laws of resemblance and of contiguity.

This being admitted, reasoning may become unconscious without our being obliged to infer a profound change in the phenomena. When it is admitted that reasoning results from a faculty of the soul, is there any more embarrassing question than to explain the unconsciousness of certain reasonings? From our point of view nothing is more simple. Reasoning is a synthesis of images. Images are the psychical part of a psycho-physiological whole; if they are wanting, the physiological

*Tyndall, *Light*, p. 101; American Ed., p. 104.

process remains; it alone is essential, and it is sufficient. The physiological mechanism acts, as if it were accompanied by its epiphenomenon, consciousness; it does its work noiselessly, and as surely arrives at the final result.

We are not able to describe this physiological process. Here we are still in the region of hypotheses; we append a *schema* which will serve merely to fix our ideas. To limit the question, let us take the visual perception of a particular object.

Every perception implies anterior states which are preparatory to it. In order that we should be able to perceive the object which is before us, to recognize its nature, its use, etc., it is necessary that, through preceding experiences, we should have associated in our mind the visual image of this object or of another of the same kind, with the train of images of all sorts which constitute our knowledge of it. How shall we express the product of these anterior experiences in physiological terms? Images have the same cerebral seat as sensations; we may suppose that each of them results from the excitation of such and such a group of cells taken in the sensory centres of the surface layers. Let us denote the visual image of the object by *a*B; these two letters will represent the two cells of the centre of vision which are supposed to vibrate when we imagine the object visually; by C D E F G H we shall denote the cells which serve as substratum to the other images of the object, tactile, muscular, etc., images.

So far the hypothesis raises no difficulties. But we have so far eliminated an essential element, the *relations*. Psychological analysis proves that a bond of association exists between the different images of an object; it is this bond which gives the group its coherence and its unity, and which enables one of the attributes of an object to suggest the others, as when the voice of a person recalls his countenance. How can we translate this association physiologically? How are two impressions, of sight and hearing for instance, bound together in the brain? For that to be the case it is necessary that they be not restricted, the one to the visual centre and the other to the auditory centre. It has been assumed that when two groups of cells—the substratum of two images—are excited at the same time, the nervous wave circulates from one group to the other through those communicating fibres which are so numerous in the brain. So, as M. Fouillée says, do the two undulations produced in a mass of water by two stones dropped at a small distance apart come to meet each other. From this fact it follows that the path between the two groups of cells under consideration is rendered easier for future waves, and that when, later on, one of the two groups will be alone excited, the current leaving it will follow that way in preference to any other, as being the *line of least resistance*. (Spencer.) In this way the elementary fact of the association of ideas has been translated into physiological terms. It has been said that groups of

cells excited at the same time are united by *dynamical associations* (Ribot), or, again, form a single and individual *cliché*. (Taine.) Thus in our example a dynamical association exists between the cells *a*B corresponding to the visual image of the object, and the cells C D E F G H corresponding to the mechanical sensations which the object gives when it is taken hold of.

Let us add one touch more, and the hypothesis is complete. We have not spoken yet of the excitative sensation which must cause this association of cells to vibrate. Analysis has taught us that in external perception the sensation always resembles in part the first image which it evokes—that is to say, the anterior vision or visual recollection of the same object, which we have denoted by *a*B. We may therefore denote the cells which will vibrate under the influence of the actual vision by the letters A*a*. The small *a* in this formula is the name of the element common to the actual vision and to the past vision; for we know that the psychical quality of resemblance has identity of seat as its physiological correlative.

When the vision begins, the nervous wave, after having traversed the group of cells A*a*, passes into the group *a*B, by means of the cellular junction afforded to it by the cell *a*. In psychological terms, the vision of the object first of all recalls, by similarity, its visual recollection. Then the nervous wave continues its path by means of the preëstablished dynamical associations, and it spreads itself

among the groups of cells denoted by C D E F G H; at the same time the recollection of all the old experiences rises in the mind; this wave of images becomes associated with the vision of the moment, and the psychical *synthesis* is formed.

Certainly such a conception of the action of the nerve centres is a true hypothesis; we have no means whatever of observing what occurs in the brain of a thinking man. All that we can affirm is that reasoning might be effected by the mechanism described, for our neuro-physiological hypothesis is traced from the subjective analysis of reasoning. Thus reasoning might be defined from the physiological point of view as the continuation of a process whose first phase (the excitation of the cells A*a*) is the only one which corresponds to an external stimulant. This is the counterpart of the psychological definition: reasoning is an extension of experience.

We leave to the reader the care of deciding whether this mechanical theory removes all activity from the mind, so as to reduce it to a purely passive state. This is a reproach which has often been made against the English school, which tries to explain all the phenomena of the mind by the laws of association. But to what extent is this reproach well-founded? Images are not by any means dead and inert things; they have active properties; they attract each other, become connected and fused together. It is wrong to make the image into a photographic stereotype, fixed and immutable. It is a living element, something which is born, some-

thing which transforms itself, and which grows like one of our nails or our hairs. Mental activity results from the activity of images as the life of the hive results from the life of the bees, or, rather, as the life of an organism results from the life of its cells.

THE END.

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