# EVOLUTION OF GENERAL IDEAS

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# THE EVOLUTION

OF

# GENERAL IDEAS

BY

TH. RIBOT

PROFESSOR IN THE COLLÈGE DE FRANCE

AUTHORISED TRANSLATION FROM THE FRENCH

BY

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CHICAGO

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# PREFACE.

THE principal aim of this work is to study the development of the mind as it abstracts and generalises, and to show that these two operations exhibit a perfect evolution: that is to say, they exist already in perception, and advance by successive and easily determined stages to the more elevated forms of pure symbolism, accessible only to the minority.

It is a commonplace to say that abstraction has its degrees, as number its powers. Yet it is not sufficient to enunciate this truism; the degrees must be fixed by clear, objective signs, and these must not be arbitrary. Thus we shall obtain precise knowledge of the various stages in this ascending evolution, and stand in less danger of confounding abstractions highly distinct by nature. Moreover, we avoid certain equivocal questions and discussions that are based entirely upon the very extended sense of the terms to *abstract* and to *generalise*.

Accordingly we have sought to establish three main periods in the progressive development of these operations: (1) inferior abstraction, prior to the appearance of speech, independent of words (though not of all signs); (2) intermediate abstraction, accompanied by words, which though at first accessory, increase in importance little by little; (3) superior ab-

straction, where words alone exist in consciousness, and correspond to a complete substitution.[1]

These three periods again include subdivisions, transitional forms which we shall endeavor to determine.

This is a study of pure psychology, from which we have rigorously to eliminate all that relates to logic, to the theory of knowledge, to first principles of philosophy. We are concerned with genesis, with embryology, with evolution only. We are thus thrown upon observation, upon the facts wherein mental processes are enunciated, and discovered. Our material, and principal sources of information, lie therefore : (1) for inferior abstracts, in the acts of animals, of children, of uneducated deaf-mutes; (2) for intermediate abstracts, in the development of languages, and the ethnographical documents of primitive or half-civilised peoples ; (3) for superior abstracts, in the progressive constitution of scientific ideas and theories, and of classifications.

This volume is a *résumé* of lectures given at the Collège de France in 1895. It is the first of a forthcoming series, designed to include all departments of psychology : the unconscious, percepts, images, volition, movement, etc.

TH. RIBOT.

March, 1897.

[1] *La parole* is here, and subsequently, translated by *speech; le mot* by *words*, or *language*,—*verbal* language being throughout understood.—*Trans.*

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# CHAPTER I.

## THE LOWER FORMS OF ABSTRACTION.

### ABSTRACTION PRIOR TO SPEECH.

SAVE in extremely rare cases,—supposing such to occur at all, as perhaps in the instant of surprise, and in states approximating to pure sensation,—save in such extremely rare cases, where the mind, like a mirror, passively reflects external impressions, intellectual activity may always be reduced to one of the two following types: associating, combining, unifying, or dissociating, isolating, and separating. These cardinal operations underlie all forms of *cognition*, from the lowest to the highest, and constitute its unity of composition.

Abstraction belongs to the second type. It is a normal and necessary process of the mind, dependent on attention, i. e., on the limitation, willed or spontaneous, of the field of consciousness. The act of abstraction implies in its genesis both negative and positive conditions, and is the result of these.

The negative conditions consist essentially in the fact that we cannot apprehend more than one quality or one aspect, varying according to the circumstances, in any complex whole,—because consciousness, like

the retina, is restricted to a narrow region of clear perception.

The positive condition is a state which has been appropriately termed a "psychical reinforcement" of that which is being abstracted, and it is naturally accompanied by a weakening of that which is abstracted from. The true characteristic of abstraction is this partial increment of intensity. While involving elimination, it is actually a positive mental process. The elements or qualities of a percept, or a representation, which we omit do not necessarily involve such suppression. We leave them out of account simply because they do not suit our ends for the moment, and are complementary.[1]

Abstraction being, then, in spite of negative appearances, a positive operation, how are we to conceive it? Attention is necessary to it, but it is more than attention. It is an augmentation of intensity, but it is more than an augmentation of intensity. Suppose a group of representations $a+b+c=d$. To abstract from $b$ and $c$ in favor of $a$, would ostensibly give $a=d-(b+c)$. If this were so, $b$ and $c$ would be retained unaltered in consciousness; there would be no abstraction. On the other hand, since it is impossible for the whole representation $d$ to be suppressed outright, $b$ and $c$ cannot be totally obliterated. They subsist, accordingly, in a residual state which may be termed $x$, and the abstract representation is hence not $a$ but $a+x$ or $A$. Thus the elements of abstract representations are the same as those of concrete representations; only some are strengthened, others weak-

[1] Schmidkunz, *Ueber die Abstraction*. Halle: Stricker, 1889. This little work of forty-three pages contains a good historical and theoretical exposition of the question.

ened: whence arise new groupings. Abstraction, accordingly, consists in the formation of new groups of representations which, while strengthening certain elements of the concrete representations, weaken other elements of the same.[1]

We see from the above that abstraction depends genetically upon the causes which awaken and sustain attention. I have described these causes elsewhere,[2] and cannot here return to their consideration.

It is sufficient to remark that abstraction, like attention, may be instinctive, spontaneous, and natural; or reflective, voluntary, and artificial. In the first category the abstraction of a quality or mode of existence originates in some attraction, or from utility; hence it is a common manifestation of intellectual life and is even met with, as we shall see, among many of the lower animals. In its second form, the rarer and more exalted, it proceeds less from the qualities of the object than from the will of the subject; it presupposes a choice, an elimination of negligible elements, which is often laborious, as well as the difficult task of maintaining the abstract element clearly in consciousness. In fine, it is always a special application of the attention which, adapted as circumstances require to observation, synthesis, action, etc., here functions as an instrument of analysis.

[1] Schmidkunz, *loc. cit.* This author, who rightly insists upon the positive character of abstraction (which is too frequently considered as a negation) observes that no concept, not even that of infinity, is in its psychological genesis the result of negation, for, "in order to deduce from the idea of a finite thing the idea of infinity, it is first necessary to abstract from that thing its quality of finality, which is certainly a positive act; subsequently, in order to reach infinity, it is sufficient either constantly to increase the time, magnitude, and intensity of the finite, which is a positive process; or to deny the limits of the finite, which is tantamount to denying the negation."

[2] *Psychology of Attention.* Chicago: The Open Court Publishing Co.

A deeply-rooted prejudice asserts that abstraction is a mental act of relative infrequency. This fallacy obtains in current parlance, where "abstract" is a synonym of difficult, obscure, inaccessible. This is a psychological error resulting from an incomplete view: all abstraction is illegitimately reduced to its higher forms. The faculty of abstracting, from the lowest to the highest degrees, is constantly the same: its development is dependent on that of (general) intelligence and of language; but it exists in embryo even in those primitive operations which are properly concerned with the concrete, i. e., perception and representation. Several recent authors have emphasised this point.[1]

Perception is *par excellence* the faculty of cognising the concrete. It strives to embrace all the qualities of its object without completely succeeding, because it is held in check by an internal foe,—the natural tendency of the mind to simplify and to eliminate. The same horse, at a given moment, is not perceived in the same manner by a jockey, a veterinary surgeon, a painter, and a tyro. To each of these, certain qualities, which vary individually, stand in relief, and others recede into the background. Except in cases of methodical and prolonged investigation (where we have observation, and not perception) there is always an unconscious selection of some principal characteristics which, grouped together, become a substitute for totality. It must not be forgotten that perception is pre-eminently a *practical* operation, that its mainspring is interest or utility, and that in consequence we neglect—i. e., leave in the field of obscure consciousness—whatever at the moment concerns neither

[1] See especially Hoeffding, *Psychologie*. German translation. Second Edition, pp. 223 et seq

our desires nor our purposes. It would be superfluous to review all the forms of perception (visual, auditory, tactile, etc.), and to show that they are governed by this same law of utility; but it should be remarked that the natural mechanism by which the strengthened elements and the weakened elements are separated, is a rude cast of what subsequently becomes abstraction, that the same forces are in play, and are ultimately reducible to some definite direction given to the attention.

With the image, the intermediate stage between percept and concept, the reduction of the object represented to a few fundamental features is still more marked. Not merely is there among the different representations which I may have of some man, dog, or tree, one that for the time being necessarily excludes the others (my oak tree perforce appears to me in summer foliage, tinted by autumn, or bereft of leaves,—in bright light or in shade), but even this individual, concrete representation which prevails over the others is no more than a sketch, a reduction of reality with many details omitted. Apart from the exceptionally gifted men in whom mental vision and mental audition are perfect, and wholly commensurate (as it would seem) with perception, the representations which we call exact are never so, except in their most general features. Compare the image we have with our eyes closed of a monument, with the perception of the monument itself; the remembrance of a melody with its vocal or instrumental execution. In the average man, the image, the would-be copy of reality invariably suffers a conspicuous impoverishment, which is enormous in the less lavishly endowed; it is

here reduced to a mere schema, limited to the inferior concepts.

Doubtless it may be objected that the work of dissociation in perception and representation is incomplete and partial. It would be strange and illogical indeed if the abstract were to triumph in the very heart of the concrete ; we do but submit that it is here in germ, in embryonic shape. And hence, when abstraction appears in its true form, as the consciousness of one unique quality isolated from the rest, it is no new manifestation but a fruition, it is a simplification of simplifications.

The state of consciousness thus attained, by the fixation of attention on one quality exclusively, and by its ideal dissociation from the rest, becomes, as we know, a notion which is neither individual nor general, but abstract,—and this is the material of generalisation.

The sense of identity, the power of apprehending resemblances, is, as has justly been said, "the keel and backbone of our thinking"; without it we should be lost in the incessant stream of things.[1] Are there in nature any complete resemblances, any absolutely similar events? It is extremely doubtful. It might be supposed that a person who reads a sentence several times in succession, who listens several times to the same air, who tastes all the four quarters of the same fruit, would experience in each case an identical perception. But this is not so. A little reflexion will show that besides differences in time, in the varying moods of the subject, and in the cumulative effect of repeated perceptions, there is at least between the first perception and the second, that radical difference

[1] W. James, *Psychology*. Vol. I., p. 459.

which separates the new from the repeated. In fact, the material given us by external and internal experience consists of resemblances alloyed by differences which vary widely in degree,—in other words, analogies. The perfect resemblance assumed between things vanishes as we come to know them better. At first sight a new people exhibits to the traveller a well-determined general type; later, the more he observes, the more the apparent uniformity is resolved into varieties. "I have taken the trouble," says Agassiz, "to compare thousands of individuals of the same species; in one case I pushed the comparison so far as to have placed side by side 27,000 specimens of one and the same shell (genus *Neretina*). I can assure you that in these 27,000 specimens I did not find two that were perfectly alike."

Is this faculty of grasping resemblances—the substrate of generalisation—primitive, in the absolute signification of the word? Does it mark the first awakening of the mind, in point of cognition? For several contemporary writers (Spencer, Bain, Schneider, and others) the consciousness of difference is the primordial factor; the consciousness of resemblance comes later. Others uphold the opposite contention.[1] As a matter of fact this quest for the *primum cognitum* is

[1] Herbert Spencer, *Principles of Psychology*. Vol. I., Part 2, Chapter II.—Bain (in the last chapter of *Emotions and Will*) says that nothing more fundamental can possibly be assigned as a mark of intelligence than the feeling of difference between consecutive or co-existing impressions. "There are cases, however, where agreement imparts the shock requisite for rousing the intellectual wave; but it is agreement so qualified as to be really a mode of difference." For a review and ample discussion of this problem see Ladd's *Psychology, Descriptive and Explanatory*, Chapter XIV. The earlier psychologists, in considering the "faculty of comparison" which acts by resemblance and difference, as primordial, had observed the same fact, although they described it in different terms.

beyond our grasp; like all genetical questions, it eludes our observation and experience.

No conclusion can be formed save on purely logical arguments, and each side advances reasons that carry a certain weight. There is, moreover, at the bottom of the whole discussion, the grave error of identifying the embryonic state of the mind with its adult forms, and of presupposing a sharp initial distinction between discrimination and assimilation. The question must remain open, incapable of positive solution by our psychology. The incontestable truth with regard to the mind, as we know it in its developed and organised state, is that the two processes advance *pari passu*, and are reciprocally causative.

In sum, abstraction and generalisation considered as elementary acts of the mind, and reduced to their simplest conditions, involve two processes:

1. The former, *abstraction*, implies a dissociative process, operating on the raw data of experience. It has subjective causes which are ultimately reducible to attention. It has objective causes which may be due to the fact that a determinate quality is given us as an integral part of widely different groups.

"Any total impression whose elements are never experienced apart must be unanalysable. If all cold things were wet and all wet things cold, if all liquids were transparent and no non-liquid were transparent, we should scarcely discriminate between coldness and wetness and scarcely ever invent separate names for liquidity and transparency. . . . . What is associated now with one thing and now with another tends to become dissociated from either, and to grow into an object of abstract contemplation by the mind. One

might call this the law of dissociation by varying concomitants."[1]

2. The latter, *generalisation*, originates in association by resemblance, but even in its lowest degree it rises beyond this, since it implies a synthetic act of fusion. It does not, in fact, consist in the successive excitation of similar or analogous percepts, as in the case where the image of St. Peter's in Rome suggests to me that of St. Paul's in London, of the Pantheon in Paris, and of other churches with enormous dimensions, of like architecture, and with gigantic domes. It is a condensation. The mind resembles a crucible with a precipitate of common resemblances at the bottom, while the differences have been volatilised. In proportion as we recede from this primitive and elementary form, the constitution of the general idea demands other psychological conditions which cannot be hastily enumerated.

And thus we reach the principal aim of the present work, which purports, not to reinforce the time-worn dispute as to the nature of abstraction and generalisation, but to pursue these operations step by step in their development, and multiform aspects. Directly we pass beyond pure individual representation we reach an ascending scale of notions which, apart from the general character possessed by all, are extremely heterogeneous in their nature, and imply distinct mental habits. The question so often discussed as to "What takes place in the mind when we are thinking by general ideas?" is not to be disposed of in one definite answer, but finds variable response according to the circumstances. In order to give an adequate reply, the principal degrees of this scale must first be

[1] W. James, *Psychology*. Vol. I., pp. 502 and 506.

determined. And for this we require an *objective notation* which shall give them some external, though not arbitrary, mark.

The first distinguishing mark is given by the absence or presence of words. Abstraction and generalisation, with no possible aid from language, constitute the inferior group which some recent writers have designated by the appropriate name of *generic images*[1] —a term which clearly shows their intermediate nature between the pure image, and the general notion, properly so-called.

The second class, which we have termed *intermediate abstraction*, implies the use of words. At their lowest stage these concepts hardly rise above the level of the generic image: they can be reduced to a vague schema, in which the word is almost a superfluous accompaniment. At a stage higher the parts are inverted: the representative schema becomes more and more impoverished, and is obliterated by the word, which rises in consciousness to the first rank.

[1] This term is borrowed from the well-known works of Galton on composite photographs, which are scarcely more than twenty years old. Huxley in his book on Hume (Chapter IV.) appears to be the first who introduced it into psychology, as shown by the following passage: "This mental operation may be rendered comprehensible 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 is produced. Thus our ideas of single complex impressions are incomplete in one way, and those of numerous, more or less similar, complex impressions are incomplete in another way; that is to say, they are generic. . . . And hence it follows that our ideas of the impressions in question are not, in the strict sense of the word, copies of those impressions; while at the same time they may exist in the mind independently of language." Romanes employs the word "recept" for "generic images," as marking their intermediate place between the "percept" which is below, and the "concept" which is above them.

Finally, the third class, that of the *higher concepts*, has for its distinguishing mark that it can no longer be represented. If any image arises in consciousness it does not sensibly assist the movement of thought, and may even impede it. Everything, apparently at least, is subordinated to language.

This enumeration of the stages of abstraction can for the present only be given roughly and broadly. Every phase of its evolution should be studied in itself, and accurately determined by its internal and external characteristics. As to the legitimacy, the objective and practical value, of this schematic distribution, nothing less than a detailed exploration from one end to the other of our subject, can confirm or overthrow it.

We shall begin, then, with the lower forms, dwelling upon these at some length, because they are usually neglected, or altogether omitted. This is the *prelinguistic* period of abstraction and generalisation: words are totally wanting; they are an unknown factor. How far is it possible without the aid of language to transcend the level of perception, and of consecutive images, and to attain a more elevated intellectual standpoint? In replying empirically, we have three fairly copious sources of information: animals, children who have not yet acquired speech, and uneducated deaf-mutes.

## ANIMALS.

It is a commonplace to say that animal psychology is full of obscurities and difficulties. These arise mainly with regard to the question now occupying us; for we are concerned with ascertaining, not

whether animals perceive, remember, and even, when their organisation is sufficiently advanced, imagine (which no one denies), but if they are capable in the intellectual order of still better and greater achievements. The common opinion is in the negative; yet this may rest entirely upon ambiguity of language. Without prejudging anything, we must interrogate the facts to hand, and link them as closely as possible in our interpretation.

As to the facts themselves we may be sparing of detail; they are to be found in special treatises, and it is superfluous to repeat them in these pages. It is moreover evident that a large portion of the animal kingdom may be neglected. In its lowest regions it is so remote from us, and has so obscure and scant a psychology, that nothing can be learned from it. In the higher forms alone can we have any chance of finding what we seek, i. e., (1) equivalents of concepts, (2) processes comparable with reasoning.

In the immense realm of the invertebrates, the highest psychical development is, by general acknowledgment, met with among the social Hymenoptera; and the capital representatives of this group are the ants. To these we may confine ourselves. Despite their tiny size, their brain, particularly among the neuters, is remarkable in structure—"one of the most marvellous atoms," says Darwin, "in all matter, not excepting even the human brain." Injuries to this organ, which are frequent in their sanguinary combats, cause disorders quite analogous to those observed in mammals. It is useless to recall what every one knows of their habits: their organisation of labor, varied methods of architecture, their wars, plundering and rape, practice of slavery, methods of education,

and (in certain species) their agricultural labors, harvesting, construction of granaries,[1] etc. We, on the contrary, must examine the exceptional cases in which the ants depart from their general habits; for their ability to abstract, to generalise, and to reason, can only be established by new adaptations to unaccustomed circumstances. The following may serve as examples:

"A nest was made near one of our tramways," says Mr. Belt, "and to get to the trees, the leaves of which they were harvesting, the ants had to cross the rails, over which the cars were continually passing and re-passing. Every time they came along a number of ants were crushed to death. They persevered in crossing for some time, but at last set to work and tunnelled underneath each rail. One day, when the cars were not running, I stopped up the tunnels with stones; but although great numbers carrying leaves were thus cut off from the nest, they would not cross the rails, but set to work making fresh tunnels underneath them."

Another observer, Dr. Ellendorf, who has carefully studied the ants of Central America, recounts a similar experience. These insects cut off the leaves of trees and carry them to their nests, where they serve various purposes. One of their columns was returning laden with spoils.

"I placed a dry branch, nearly a foot in diameter, obliquely across their path, which was lined on either side by an impassable barrier of high grass, and pressed it down so tightly on the ground that they

[1] For details see Romanes, *Animal Intelligence*, Chapters III. and V. As to the probability of their possessing means of communication for assistance in their co-operative labors see below, Chapter II.

could not creep underneath. The first comers crawled beneath the branch as far as they could, and then tried to climb over, but failed owing to the weight on their heads. . . . They then stood still as if awaiting a word of command, and I saw with astonishment that the loads had been laid aside by more than a foot's length of the column, one imitating the other. And now work began on both sides of the branch, and in about half an hour a tunnel was made beneath it. Each ant then took up its burden again, and the march was resumed in the most perfect order."

They also show considerable inventiveness in the construction of bridges. It appears from numerous observations that they know how to place straws on the surface of water, and to keep them in equilibrium or unite their several ends together with earth, moisten them with their saliva, restore them when destroyed, and to construct a highway made of grains of sand, etc. (Réaumur.) They even employ living bridges: "The ground about a maple tree having been smeared with tar so as to check their ravages, the first ants who attempted to cross stuck fast. But the others were not to be thus entrapped. Turning back to the tree they carried down aphides which they deposited on the tar one after another until they had made a bridge over which they could cross the tarred spot without danger."[1]

I shall cite no observations on the intelligence of wasps and bees, but I wish to note one rudimentary case of generalisation. Huber remarked that bees bite holes through the base of corollas when these are so long as to prevent them from reaching the honey in the ordinary way. They only resort to

[1] Romanes. *Animal Intelligence*, Chapter III.

this expedient when they find they cannot reach the nectar from above; "but having once ascertained this, they forthwith proceed to pierce the bottoms of all the flowers of the same species." Doubtless association and habit may be invoked here, but before these were produced, was there not an extension of like to like?

For the higher animals I shall also restrict myself to the upper types. We shall of course reject all observations relating to "performing" animals, all acquirements due to education and training by man, as also the cases in which, as in the beaver, there is a perplexing admixture of instinct so called (a specific property), and adaptation, varying according to time and place.

The elephant has a reputation for intelligence which may be somewhat exaggerated. His psychology is fairly well known. We may cite a few characteristic traits that bear upon our subject. He will tear up bamboo canes from the ground, break them with his feet, examine them, and repeat the operation until he has found one that suits him; he then seizes the branch with his trunk and uses it as a scraper to remove the leeches which adhere to his skin at some inaccessible part of his body. "This is a frequent occurrence, such scrapers being used by each elephant daily." When he is tormented by large flies he selects a branch which he strips of its leaves, except at the top, where he leaves a fine bunch. "He will deliberately clean it down several times, and then laying hold of its lower end he will break it off, thus obtaining a fan or switch about five feet long, handle included. With this he keeps the flies at bay. Say what we may, these are both really *bona fide* imple-

ments, each intelligently made for a definite purpose."

"What I particularly wish to observe," says an experienced naturalist, "is that there are good reasons for supposing that elephants possess abstract ideas; for instance, I think it is impossible to doubt that they acquire through their own experience notions of hardness and weight, and the grounds on which I am led to think this are as follows. A captured elephant, after he has been taught his ordinary duty, say about three months after he is taken, is taught to pick up things from the ground and give them to his mahout sitting on his shoulders. Now for the first few months it is dangerous to require him to pick up anything but soft articles, such as clothes, because the things are often handed up with considerable force. After a time, longer with some elephants than others, they appear to take in a knowledge of the nature of the things they are required to lift, and the bundle of clothes will be thrown up sharply as before, but heavy things, such as a crowbar or piece of iron chain, will be handed up in a gentle manner; a sharp knife will be picked up by its handle and placed on the elephant's head, so that the mahout can also take it by the handle. I have purposely given elephants things to lift which they could never have seen before, and they were all handled in such a manner as to convince me that they recognised such qualities as hardness, sharpness, and weight."

Lloyd Morgan, who, in his books on comparative psychology, is evidently disposed to concede as small a measure of intelligence to animals as possible, comments upon the above observation as follows:[1]

[1] C. Lloyd Morgan. *Animal Life and Intelligence*, Chapter IX., p. 364.

"Are we to suppose that these animals possess abstract ideas? I reply—That depends upon what is meant by abstract ideas. If it is implied that the abstract ideas are *isolates;* that is, qualities considered quite apart from the objects of which they are characteristic, I think not. But if it be meant that elephants, in a practical way, 'recognise such qualities as hardness, sharpness, and weight,' as *predominant* elements in the constructs they form, I am quite ready to assent to the proposition."

I agree fully with this conclusion, adding the one remark that between the pure abstract notion and the "predominant" notion so called, there is only a difference of degree. If the predominant element is not isolated, detached, and fixed by a sign, it is certainly near being so, and deserves on this ground to be called an abstract of the lower order.

The observation of Houzeau has been frequently quoted respecting dogs, which, suffering from thirst in arid countries, rush forty or fifty times into the hollows that occur along their line of march in the hope of finding water in the dry bed. They could not be attracted by the smell of the water, nor by the sight of vegetation, for these are wanting. They must thus be guided by general ideas, which are doubtless of an extremely simple character, and, in some measure, supported by experience."

It is on this account that the term "generic image" would in my opinion be preferable for describing cases of this character.

"I have frequently seen not only dogs, but horses, mules, cattle, and goats, go in search of water in places which they had never visited before. They are guided by general principles, because they go to these

watering places at times when the latter are perfectly dry.[1] Undoubtedly it may be objected that association of images here plays a preponderating part. The sight of the hollows recalls the water which, though absent, forms part of a group of sensations which has been perceived many times; but since the generic image is, as we shall see later, no more than an *almost passive* condensation of resemblances, these facts clearly indicate its nature and its limits.

I shall merely allude without detailed comment to the numerous observations on the aptitude of dogs and cats for finding means to accomplish their aims, the anecdotes of their mechanical skill, and the ruses (so well described by G. Leroy) which the fox and the hare employ to outwit the hunter, "when they are old and schooled by experience; since it is to their knowledge of facts that they owe their exact and prompt inductions." The most intelligent of all animals, the higher orders of monkeys, have not been much studied in their wild state, but such observations as have been made, some of which have been contributed by celebrated naturalists, fix with sufficient distinctness the intellectual level of the better endowed. The history of Cuvier's orang-outang has been quoted to satiety. The more recent books on comparative psychology contain ample testimony to their ability to profit by experience[2] and to construct instruments. A monkey, not having the strength to lift up the lid of a chest, employed a stick as a lever. "This use of a lever as a mechanical instrument is an action to which no animal other than a monkey has

[1] Houzeau, *Etudes sur les facultés mentales des animaux*, Vol. II., p. 264 et seq. The same author gives an example of generalisation in bees.

[2] Darwin, *The Descent of Man*, Vol. I., Chapter III.

ever been known to attain." Another monkey observed by Romanes, also "succeeded by methodical investigation, *without assistance*, in discovering for himself the mechanical principle of the screw; and the fact that monkeys well understand how to use stones as hammers, is a matter of common observation." They are also skilful in combining their stratagems, as in the case of one who, being held captive by a chain, and thus unable to reach a brood of ducklings, held out a piece of bread in one hand, and on tempting a duckling within his reach, seized it by the other, and killed it with a bite in the breast."[1]

One mental operation remains which must be examined separately, and in its study we shall pursue the same method, wherever it occurs, throughout this work. The process in question has the advantage of being perfectly definite, of restricted scope, completely evolved, and accessible to research in all the phases of its development, from the lowest to the highest. It is that of *numeration.*

Are there animals capable of counting? G. Leroy is, I believe, the first who answered this question in the affirmative, in a passage which is worth transcribing, although it has been often quoted. "Among the various ideas which necessity adds to the experience of animals, that of number must not be overlooked. Animals count,—so much is certain; and although up to the present time their arithmetic appears weak, it may perhaps be possible to strengthen it. In countries where game is preserved, war is made upon magpies because they steal the eggs of other birds. . . . . And in order to destroy this greedy family at a blow, game-keepers seek to destroy the mother while

[1] Romanes, *loc. cit.*, Chapter XVII.

sitting. To do this it is necessary to build a well-screened watch-house at the foot of the tree where the nests are, and in this a man is stationed to await the return of the parent bird, but he will wait in vain if the bird has been shot at under the same circumstances before. . . . . To deceive this suspicious bird, the plan was hit upon of sending two men into the watch-house, one of them passed on while the other remained; but the magpie counted and kept her distance. The next day three went, and again she perceived that only two withdrew. It was eventually found necessary to send five or six men to the watch-house in order to put her out of her calculation. . . . . This phenomenon, which is repeated as many times as the attempt is made, is one of the most extraordinary instances of the sagacity of animals." Since then the question has been repeatedly taken up. Lubbock devotes to it the three last pages of his book *The Senses of Animals*. According to his observations on the nests of birds, one egg may be taken from a nest in which there are four, but if we take away two, the bird generally deserts its nest. The solitary wasp provisions its cell with a fixed number of victims. Sand wasps are content with one. One species of *Eumenes* prepares five victims for its young, another species ten, another fifteen, another twenty-four; but the number of the victims is always the same for the same species. How does the insect know its characteristic number?[1]

An experiment, methodically conducted by Romanes, proved that a chimpanzee can count correctly

[1] At the end of the passage in question there is an extraordinary account of the arithmetical powers of a dog which Lubbock explains by "thought reading." I omit this instance, since we are deliberately rejecting all rare or doubtful cases.

as far as five, distinguishing the words which stand for one, two, three, four, five, and at command deliver the number of straws requested of her.[1]

Although the observations on this point are not yet sufficiently varied and extended to enable us to speak of them as we should wish, it must be remarked that the cases cited are not alike, and that it would be illegitimate to reduce them all to one and the same psychological mechanism.

1. The case of insects is the most embarrassing. It is but candid to state a *non liquet*, since to attribute their achievements to unconscious numeration, or to some special equivalent instinct, is tantamount to saying nothing. Besides, we are not concerned with anything relating to instinct.

2. The case of the monkey and his congeners stands high in the scale: it is a form of *concrete* numeration which we shall meet again in children, and in the lowest representatives of humanity.

3. All the other cases resemble the alleged "arithmetic" of G. Leroy's magpie and similar observations. I see here not a numeration, but a perception of plurality, which is something quite different. There are in the brain of the animal a number of co-existing perceptions. It knows if all are present, or if some are lacking; but a consciousness of difference between the entire group, and the diminished defective group, is not identical with the operation of counting. It is a preliminary state, an introduction, nothing more, and the animal does not pass beyond this stage, does not count in the exact sense of the word. We shall see further on that observations with young children furnish proofs in favor of this assertion, or at

[1] *Mental Evolution in Man*, Chapter III., p. 58.

least show that it is not an unfounded presumption, but the most probable hypothesis.

We may now without further delay (while reserving the facts which are to be studied in the sequel to this chapter) attempt to fix the nature of the forms of abstraction, and of reasoning, accessible to the higher animal types.

1. The generic image results from a *spontaneous* fusion of images, produced by the repetition of similar, or very analogous, events. It consists in an almost passive process of assimilation; it is not intentional, and has for its subject only the crudest similarities. There is an accumulation, a summation of these resemblances; they predominate by force of numbers, for they are in the majority. Thus there is formed a solid nucleus which predominates in consciousness, an abstract appurtenant to all similar objects; the differences fall into oblivion. Huxley's comparison of the composite photographs (above cited) renders it needless to dwell on this point. Their genesis depends on the one hand on experience; only events that are frequently repeated can be condensed into a generic image: on the other hand on the affective dispositions of the subject (pleasure, pain, etc.), on interest, and on practical utility, which render certain perceptions predominant. They require, accordingly, no great intellectual development for their formation, and there can be no doubt that they exist quite low down in the animal scale. The infant of four or five months very probably possesses a generic image of the human form and of some similar objects. It may be remarked, further, that this lower form of abstraction can occur also in the adult and cultivated man. If, e. g., we are suddenly transported into a country

whose flora is totally unknown to us, the repetition of experiences suggests an unconscious condensation of similar plants; we classify them without knowing their names, without needing to do so, and without clearly apprehending their distinguishing characteristics, those namely which constitute the true abstract idea of the botanist.

In sum, the generic image comes half way between individual representation, and abstraction properly so called. It results almost exclusively from the faculty of apprehending resemblances. The rôle of dissociation is here extremely feeble. Everything takes place, as it were, in an automatic, mechanical fashion, in consequence of the unequal struggle set up in consciousness between the resemblances which are strengthened, and the differences, each of which remains isolated.

2. It has been said that the principal utility of abstraction is as an instrument in ratiocination. We may say the same of generic images. By their aid animals reason. This subject has given rise to extended discussion. Some writers resent the mere suggestion that ants, elephants, dogs, and monkeys, should be able to reason. Yet this resentment is based on nothing but the extremely broad and elastic signification of the word reasoning—an operation which admits of many degrees, from simple, empirical consecutiveness to the composite, quantitative reasoning of higher mathematics. It is forgotten that there are here, as for abstraction and for generalisation, *embryonic* forms —those, i. e., which we are now studying.

Taken in its broadest acceptation, reasoning is an operation of the mind which consists in passing from the known to the unknown; in passing from what is

immediately given, to that which is simply suggested by association and experience. The logician will unquestionably find this formula too vague, but it must necessarily be so, in order to cover all cases.

Without pretending to any rigorous enumeration, beyond all criticism, we can, in intellectual development, distinguish the following phases in the ascending order: perceptions and images (memories) as point of departure; association by contiguity, association by similarity; then the advance from known to unknown, by reasoning from particular to particular, by analogical reasoning, and finally by the perfect forms of induction and deduction, with their logical periods. Have all these forms of reasoning a common substrate, a unity of composition? In other words, can they be reduced to a single type—of induction according to some, of deduction according to others? Although the supposition is extremely probable, it would not be profitable to discuss the question here. We must confine ourselves to the elementary forms which the logicians omit, or despise, for the most part, but which, to the psychologist, are intellectual processes as interesting as any others.

Without examining whether, as maintained by J. S. Mill, all inference is actually from particular to particular (general propositions being under this hypothesis only simple *reminders*, brief formulæ serving as a base of operations) it is clear that we have in it the simplest form of mental progress from the known to the unknown. At the same time it is more than mere association, though transcending it only in degree. Association by similarity is not, as we have seen, identical with formation of generic images; this last implies fusion, mental synthesis. So, too, rea-

soning from particular to particular implies something more than simple association; it is a state of *expectation* equivalent to a conclusion in the empirical order; it is an anticipation. The animal which has burned itself in swallowing some steaming food, is on its guard in future against everything that gives off steam. Here we have more than simple association between two anterior experiences (steam, burning); and this state "differs from simple associative suggestion, by the fact that the mind is less occupied with the memory of past burns than with the expectation of a repetition of the same fact in the present instance; that is to say, that it does not so much recall the fact of having once been burnt as it draws the conclusion that it will be burnt."[1]

Otherwise expressed, he is orientated less towards the past than towards the future. Granted that this tendency to believe that what has occurred once or twice will occur invariably, is a fruitful source of error, it remains none the less a logical operation (judgment or ratiocination) containing an element more than association: an inclusion of the future, an implicit affirmation expressed in an act. Doubtless, between these two processes,—association, inference from particular to particular—the difference is slight enough; yet in a study of genesis and evolution, it is just these transitional forms that are the most important.

Reasoning by analogy is of a far higher order. It is the principal logical instrument of the child and of primitive man: the substrate of all extension of lan-

[1] J. Sully, *The Human Mind*, I., 460. The author gives excellent diagrams to represent the difference in the two cases. For reasoning from particular to particular, cf. also J. S. Mill, *Logic*, II., Chapter III., p. 3; Bradley, *Logic*, II., Chapter II., p. 2.

guage, of vulgar and empirical classifications, of myths, of the earliest, quasi-scientific knowledge.[1] It is the commencement of induction, differing from the latter, not in form, but in its imperfectly established content. "Two things are alike in one or several characteristics; a proposition stated is true of the one, therefore it is true of the other. *A* is analogous to *B; m* is true of *A*, therefore *m* is true of *B* also." So runs the formula of J. S. Mill. The animal, or child, which when ill-treated by one person extends its hatred to all others that resemble the oppressor, reasons by analogy. Obviously this procedure from known to unknown will vary in degree,—from zero to the point at which it merges into complete induction.

With these general remarks, we may return to the logic of animals or rather to the sole kind of logic possible without speech. This is, and can only be, a *logic of images* (Romanes employs a synonymous expression, *logic of recepts*), which is to logic, properly so called, what generic images are to abstraction and to generalisation proper. This denomination is necessary; it enables us to form a separate category, well defined by the absence of language; it permits us, in speaking of judgment and ratiocination in animals, and in persons deprived of speech, to know exactly what meaning is intended.

It follows that there are two principal degrees in the *logic of images.*

1. Inference from particular to particular. The bird which finds bread upon the window, one morning, comes back next day at the same hour, finds it again, and continues to come. It is moved by an as-

[1] *In re* analogy, consult Stern's monograph, *Die Analogie im volksthümlichen Denken*, Berlin, 1894.

sociation of images, *plus* the state of awaiting, of anticipation, as described above.

2. Procedure by analogy. This (at least in its higher forms in animal intelligence) presupposes mental construction: the aim is definite, and means to attain it are invented. To this type I should refer the cases cited above of ants digging tunnels, forming bridges, etc. The ants are wont to practise these operations in their normal life; their virtue lies in the power of *dissociation* from their habitual conditions, from their familiar ant-heap, and of adaptation to new and unknown cases.

The logic of images has characteristics which pertain to it exclusively, and which may be summarised as follows:

1. As material it employs concrete representations or generic images alone, and cannot escape from this domain. It admits of fairly complex constructions, but not of substitution. The tyro finds no great difficulty in solving problems of elementary arithmetic (such as: 15 workmen build a wall 3 metres high in 4 days; how long will it take 4 men to build it?), because he uses the logic of signs, replacing the concrete facts by figures, and working out the relations of these. The logic of images is absolutely refractory to attempts at substitution. And while it thus acts by representation only, its progress even within this limit is necessarily very slow, encumbered, and embarrassed by useless details, for lack of adequate dissociation. At the same time it may, in the adult who is practised in ratiocination, become an auxiliary in certain cases; I am even tempted to regard it as the main auxiliary of constructive imagination. It would be worth while to ascertain, from authentic observations, what part it

plays in the inventions of novelists, poets, and artists. In a polemic against Max Müller, who persists in affirming that it is radically impossible to think and reason without words, a correspondent remarks:

"Having been all my life since school-days engaged in the practice of architecture and civil engineering, I can assure Prof. Max Müller that designing and invention are done entirely by mental pictures. I find that words are only an encumbrance. In fact, words are in many cases so cumbersome that other methods *have* been devised for imparting knowledge. In mechanics the graphic method, for instance."[1]

2. Its aim is always practical. It should never be forgotten that at the outset, the faculty of cognition is essentially utilitarian, and cannot be otherwise, because it is employed solely for the preservation of the individual (in finding food, distinguishing enemies from prey, and so on). Animals exhibit only *applied* reasoning, tested by experience; they feel about and choose between several means,—their selection being justified or disproved by the final issue. Correctly speaking, the logic of images is neither true nor false; these epithets are but half appropriate. It succeeds or fails; its gauge is success or defeat; and as we maintained above that it is the secret spring of æsthetic invention, let it be noticed that here again there is no question of truth or error, but of creating a successful or abortive work.

Accordingly, it is only by an unjustifiable restriction that the higher animals can be denied all func-

[1] *Three Introductory Lectures on the Science of Thought, delivered at the Royal Institution*, appendix, p. 6, letter 4; Chicago, 1888. It should, however, be remembered that the writer who thus uses the logic of images has a mind preformed by the logic of signs: which is not the case with animals.

tions beyond that of association, all capacity for inference by similarity. W. James (after stating that, *as a rule*, the best examples of animal sagacity "may be perfectly accounted for by mere contiguous association, based on experience"), arrives virtually at a conclusion no other than our own. After recalling the well-known instance of arctic dogs harnessed to a sledge and scattering when the ice cracked to distribute their weight, he thus explains it: "We need only suppose that they have individually experienced wet skins after cracking, that they have often noticed cracking to begin when they were huddled together and that they have observed it to cease when they scattered." Granting this assumption, it is none the less true that associations by contiguity are no more than the *material* which serves as a substratum for inference by similarity, and for the act which follows. Again, a friend of James, accompanied by his dog, went to his boat and found it filled with dirt and water. He remembered that the sponge was up at the house, and not caring to tramp a third of a mile to get it, he enacted before his terrier (as a forlorn hope) the necessary pantomime of cleaning the boat, saying: "Sponge, sponge, go fetch the sponge." The dog trotted off and returned with it in his mouth, to the great surprise of his master. Is this, properly speaking, an act of reasoning? It would only be so, says James, if the terrier, not finding the sponge, had brought a rag, or a cloth. By such substitution he would have shown that, notwithstanding their different appearance, he understood that for the purpose in view, all these objects were identical. "This substitution, though impossible for the dog, any man but the stupidest could not fail to do." I am not sure of

this, despite the categorical assertion of the author; yet, discussion apart, it must be admitted that this would be asking the dog to exhibit a man's reason.[1] As a matter of fact, notwithstanding contrary appearances, James arrives at a conclusion not very different from our own. "The characters extracted by animals are very few, and always related to their immediate interests and emotions." This is what we termed above, empirical reasoning.[2]

G. Leroy said: "Animals reason, but differently from ourselves." This is a negative position. We advance a step farther in saying: their reasoning consists in a heritage of concrete or generic images, adapted to a determined end,—intermediary between the percepts and the act. It is impossible to reduce everything to association by similarity, much less by contiguity, alone; since such procedure results necessarily in the formation of unchangeable habits, in limitation to a narrow routine, whereas we have seen that certain animals are capable of breaking through such restrictions.

1 *Psychology*, II., 348 et seq. James, however, recalls the case of another dog accustomed to find and carry wedges for splitting wood. One day he did not return. After half an hour they looked for him; he was biting and tearing at the handle of a hatchet stuck in a block (the wedge was not forthcoming). Had this animal clear perception of the common character of the two instruments used for splitting? "This interpretation is possible, but it seems to me far to transcend the limits of ordinary canine abstraction." (*Loc. cit.*, p. 352.) James attempts another explanation. It is singular that he does not invoke training, and association with man: that this is an influential factor in the intellectual development of animals cannot be doubted. It is advisable to adduce exclusively their spontaneous inventions, with no possible suggestion: such facts alone are clear and convincing.

2 Lloyd Morgan, whose tendencies have already been indicated, distinguishes three sorts of inferences: (1) unconscious inference on immediate construction (perceptual); (2) intelligent inference (conceded to animals), dealing with constructs and reconstructs (perceptual); and (3) rational inference, implying analysis and isolation (conceptual). (*Op. cit.*, p. 362.)

## ON CHILDREN.

We are here concerned with children who have not yet learned to speak, and with such alone. In contradistinction to animals, and to deaf-mutes when left to themselves, infancy represents a transitory state of which no upper limit can be fixed, seeing that speech appears progressively. The child forms his baby-vocabulary little by little, and at first imposes it upon others, until such time as he is made to learn the language of his country. We may provisionally neglect this period of transition, studying only the dumb, or monosyllabic and gesture phase.

The problem proposed at the end of the seventeenth century (perhaps before), which divided philosophers into two camps, was whether the human individual starts with general terms, or with particulars. At a later time, the question was proposed for the human race as a whole, in reference to the origin of language.

Locke maintained the thesis of the particular: "The ideas that children form of the persons with whom they converse resemble the persons themselves, and can only be particular."

So, too, Condillac, Adam Smith, Dugald Stewart, and the majority of those who represent the so-called sensationalist school.

The thesis of the general was upheld by authors of no less authority, commencing with Leibnitz:

"Children, and those who are ill-acquainted with the language they desire to speak, or the matter whereof they discourse, make use of general terms,

such as *thing*, *animal*, *plant*, in lieu of the proper terms which are wanting to them; and it is certain that all proper or individual names were originally appellative or general."[1]

The problem cannot be accepted under this form by contemporary psychology. It is equivocal. Its capital error is in applying to the embryonic state of intelligence and of language, formulæ that are appropriate to adult life only—to the growing mind, categories valid for the formed intellect alone. A reference to the physiology of the human embryo will render this more intelligible. Has this embryo, up to three months, a nose or mouth? Is it male or female? etc. Students of the development of intra-uterine life in its first phases are very cautious in propounding these and similar questions in such a manner; they do not admit of definite answers. That which is in the state of envelopment and of incessant becoming, can only be compared remotely with that which is fixed and developed.

The sole permissible formula is this: Intelligence progresses from the indefinite to the definite. If "indefinite" is taken as synonymous with general, it may be said that the particular does not appear at the outset; but neither does the general in any exact sense: the vague would be more appropriate. In other words, no sooner has the intellect progressed beyond the moment of perception and of its immediate reproduction in memory, than the generic image makes its appearance, i. e., a state intermediate between the particular and the general, participating in the nature of the one and of the other—a confused simplification.

[1] *Nouveaux Essais*, Book III., Chapter I.

Recent works on the psychology of infancy abound in examples of these abstractions and inferior generalisations, which appear very early.[1] A few examples will suffice.

Preyer's child (aged thirty-one weeks) interested itself exclusively in bottles, water-jugs, and other transparent vases with white contents; it had thus seized upon a characteristic mark of one thing that was important to it, to wit—milk. At a later period it designated these by the syllable *môm*. Taine records an analogous case of a child to whom *mm* and *um*, and then *nim* at first signified the pleasure of seeing its pap, and subsequently everything eatable. We are assisting at the genesis of the sign; the crude sound attached to a group of objects becomes at a later period the sign of those objects, and later still an instrument of substitution. Sigismund showed his son, aged less than one year, and incapable of pronouncing a single word, a stuffed grouse, saying "bird." The child immediately looked across to the other side of the room where there was a stuffed owl. Another child having listened first with its right ear, then with its left, to the ticking of a watch, stretched out its arms gleefully towards the clock on the chimney-piece (auditory, not vocal, generic image).

Without multiplying examples known to every one, which give peremptory proof of the existence of abstraction (partial dissociation), and of generalisation, prior to speech, let us rather consider the heterogeneous nature of these generic images, the result of their mode of formation. They are in fact constructed arbitrarily,—as it were by accident, depend-

[1] Cf. Taine, *L'Intelligence*, Vol. I., Book I., Chapter II., Part 2, Note 1. Preyer, *Die Seele des Kindes*, Chapter XVI.

ing partly on the apprehension of gross resemblances, partly, and chiefly, on subjective causes, emotional dispositions, practical interests. More rarely they are based upon essential qualities.

John Stuart Mill affirms that the majority of animals divide everything into two categories: that which is, and that which is not edible. Whatever we may think of this assertion, we should probably feel much astonishment if we could penetrate and comprehend certain animal generalisations. In the case of children we can do more than assume. Preyer's son employed the interjection *ass* (which he had forged or imitated) first for his wooden horse, mounted on wheels, and covered with hair; next for everything that could be displaced or that moved (carts, animals, his sister, etc.), and that had hair. Taine's little girl (twelve months), who had frequently been shown a copy of an infant Jesus, from Luini, and had been told at the same time, "That is the baby," would in another room, on hearing any one ask her, "Where is the baby?" turn to any of the pictures or engravings, no matter what they were. *Baby* signified to her some general thing: something which she found in common in all these pictures, engravings of landscapes, and figures, i. e., if I do not mistake, some variegated object in a shining frame. Darwin communicated the following observation on one of his grandsons to Romanes:

"The child, who was just beginning to speak, called a duck 'quack,' and, by special association, it also called water 'quack.' By an appreciation of the resemblance of qualities, it next extended the term 'quack' to denote all birds and insects on the one hand, and all fluid substances on the other. Lastly,

by a still more delicate appreciation of resemblance, the child eventually called all coins 'quack,' because on the back of a French sou it had once seen the representation of an eagle."[1]

In this case, to which we shall return later, there was a singular mixture of intellectual operations: creation of a word by onomatopœia (resemblance) and finally an unbridled extension of analogy.

Such observations might be multiplied. They would only confirm this remark: the generic image varies in one case and another, because the condensation of resemblances of which it is constituted depends often upon a momentary impression, upon most unexpected conditions.

The development of *numeration* in the child takes us to some extent out of the pre-linguistic period; but it is advisable to consider it at this point. In the first place we have to distinguish between what is learnt and what is comprehended. The child may recite a series of numerical words that have been taught to him: but so long as he fails to apply each term of the series correctly to a number of corresponding objects, he does not understand it. For the rest, this comprehension is only acquired slowly and at a somewhat late period.

"The only distinction which the child makes at first is between the simple object and plurality. At eighteen months, he distinguishes between one, two, and several. At the age of three, or a little earlier, he knows one, two, and four ($2 \times 2$). It is not until later that he counts a regular series; one, two, three, four. At this point he is arrested for some time. Hence the Brahmans teach their pupils of the first class to count

[1] Romanes, *Mental Evolution in Man*, p. 283.

up to four only; they leave it to the second class to count up to twenty. In European children of average intelligence, the age of six to seven years is required before they can count to ten, and about ten years to count to one hundred. The child can doubtless repeat before this age a numeration which it has been taught, but this is not what constitutes knowledge of numbers; we are speaking of determining number by objects."[1] B. Pérez states that his personal observations have not furnished any indication contradictory to the assertions of Houzeau. An intelligent child of two and a half was able to count up to nineteen, but had no clear idea of the duration of time represented by three days; it had to be translated as follows: "not to-day but to-morrow, and another to-morrow."[2]

This brings us back to the question, discussed above, of the numeration claimed for animals. Preyer tells us of one of his children that "it was impossible to take away one of his ninepins without its being discovered by the child, while at eighteen months he knew quite well whether one of his ten animals was missing or not." Yet this fact is no proof that he was able to count up to nine or ten. To represent to oneself several objects, and to be aware that one of them is absent, and not perceived—is a different thing from the capacity of counting them numerically. If the shelves of a library contain several works that are well known to me, I can see that one is missing without knowing anything about the total number of books upon the shelves. I have a juxtaposition of images (visual or tactile), in which a gap is produced.

For the rest, much light is thrown on this ques-

[1] B. Pérez, *op. cit.*, 219. [2] Houzeau, *op. cit.*, II., 202.

tion by Binet's ingenious experiments. Their principal result may be summarised as follows.[1] A little girl of four does not know how to read or count; she has simply learnt a few figures and applies them exactly to one, two, or three objects; above this she gives chance names, say six or twelve, indifferently to four objects. If a group of fifteen counters, and another group of eighteen, of the same size, are thrown down on the table, without arranging them in heaps, she is quick to recognise the most numerous group. The two groups are then modified, adding now to the right, now to the left, but so that the ratio fourteen to eighteen is constant. In six attempts the reply is invariably exact. With the ratio seventeen-eighteen, the reply is correct eight times, wrong once. If, however, the groups are found with counters of unequal diameter, everything is altered. Some (green) measure two and one-half centimetres, others (white) measure four centimetres. Eighteen green counters are put on one side, fourteen white counters on the other. The child then makes a constant error, and takes the latter group to be the more numerous, and the group of fourteen may even be reduced to ten without altering her judgment. It is not until nine that the group of eighteen counters appear the more numerous.

This fact can only be explained by supposing that the child appreciates by *space*, and not by number, by a perception of continuous and not by discontinuous size—a supposition which agrees with other experiments by the same author to the effect that, in the comparison of lines, children can appreciate differences of length. At this intellectual stage, numeration is accordingly very weak, and restricted to the nar-

[1] Cf. *Revue Philosophique*, July, 1890.

rowest limits. As soon as these are exceeded, the distribution between minus and plus rests, not upon any real numeration, but upon a difference of mass, felt in consciousness.

In children, *reasoning* prior to speech is, as with animals, practical, but well adapted to its ends. No child, if carefully watched, will fail to give proof of it. At seventeen months, Preyer's child, which could not speak a word, finding that it was unable to reach a plaything placed above its reach in a cupboard, looked about to the right and left, found a small travelling trunk, took it, climbed up, and possessed itself of the desired object. If this act be attributed to imitation (although Preyer does not say this), it must be granted that it is imitation of a particular kind,—in no way comparable with a servile copy, with repetition pure and simple,—and that it contains an element of invention.

In analysing this fact and its numerous analogues, we became aware of the fundamental identity of these simple inferences with those which constitute speculative reasoning: they are of the same character. Take, for instance, a scientific definition, such as that of Boole, which seems at first sight little adapted to this connexion. "Reasoning is the elimination of the middle term in a system that has two terms." Notwithstanding its theoretical aspect, this is rigorously applicable to the cases with which we are occupied. Thus, in the mind of Preyer's child, there is a first term (desire for the plaything), a last term (possession); the remainder is the method, scaffolding, a mean term to be eliminated. The intellectual process in both instances, practical and speculative, is identical; it is a mediate operation, which develops by a

series of acts in animals and children, by a series of concepts and words in the adult.

### DEAF-MUTES.

In studying intellectual development prior to speech, the group of deaf-mutes is sufficiently distinct from those which we have been considering. Animals do not communicate all their secrets, and leave much to be conjectured. Children reveal only a transitory state, a moment in the total evolution. Deaf-mutes (those at least with whom we are dealing) are adults, comparable as such to other men, like them, save in the absence of speech and of what results from it. They have reached a stable mental state. Moreover, those who are instructed at a late period, who learn a language of analytical signs, i. e., who speak with their fingers, or emit the sounds which they read upon the lips of others, are able to disclose their anterior mental state. It is possible to compare the same man with himself, before and after the acquisition of an instrument of analysis. Subjective and objective psychology combine to enlighten us.

The intellectual level of such persons is very low (we shall return to this): still their inferiority has been exaggerated, especially in the last century, by virtue of the axiom, it is impossible to think without words. Discussion of this antique aphorism is unnecessary; in its rigorous form it finds hardly any advocates of note.[1] Since thought is synonymous with

[1] Max Müller, however, is an exception. He has not made the smallest concession on this point in any of his works, including the last (*Three Lectures*, etc., cited above). He even maintains that a society of deaf-mutes would hardly rise above the intellectual level of a chimpanzee. "A man born dumb, notwithstanding his great cerebral mass and his inheritance of strong intellectual instincts, would be capable of few higher intellectual manifestations than an orang or a chimpanzee, if he were confined to the society of

comparing, abstracting, generalising, judging, reasoning, i. e., with transcending in any way the purely sensorial and affective life, the true question is not, Do we think without words? but, To what extent can we think without words? Otherwise expressed, we have to fix the upper limit of the logic of images, which evidently reaches its apogee in adult deaf-mutes. Further, even in this last case, thought without language does not attain its full development. The deaf-mute who is left without special education, and who lives with men who have the use of speech, is in a less favorable situation than if he forms a society with his equals. Gérando, and others after him, remarked that deaf-mutes in their native state communicate easily with one another. He enumerates a long series of ideas, which they express in their mimicry, and gestures, and many of these expressions are identical in all countries.

"Children of about seven years old who have not yet been educated, make use of an astonishing number of gestures and very rapid signs in communicating

dumb associates" (p. 92). This thesis was attacked by thirteen critics, including Romanes, Galton, the Duke of Argyle, etc., but Max Müller meets them all and replies to them without flinching. It must be confessed that the arguments invoked by his correspondents are very unequal in merit. Some are convincing, others not. The Duke of Argyle says happily that "words are necessary to the progress of thought, but not at all to the *act* of thinking." Ebbels (p. 13, appendix) shows that Max Müller has unduly limited the question by excluding all processes anterior to the formation of concepts; we think in images; the transition from one form to another is imperceptible, and the faculty of abstraction does not appear suddenly along with the signs. On the other hand, we cannot admit as evidence the facts invoked by other correspondents, e. g., chess-players who combine and calculate solely by the aid of visual images; answers to letters, conceived in the first place as a general plan before they are developed in words, etc. It is forgotten that the persons capable of these operations have had long practice in verbal analysis, thereby attaining a high intellectual level. So, in the physical order, the practical gymnast, even when not executing any particular feat, possesses a suppleness and agility of body, due to exercise, which translates itself into all his movements.

with each other. *They understand each other naturally with great facility.* . . . No one teaches them the initial signs, which are, in great part, unaltered imitative movements."

The study of this spontaneous, natural language is the sole process by which we can penetrate to their psychology, and determine their mode of thought. Like all other languages, it comprises a vocabulary and a syntax. The vocabulary consists in gestures which designate objects, qualities, acts; these correspond to our substantives and verbs. The syntax consists in the successive order of these gestures and their regular arrangement; it translates the movement of thought and the effort towards analysis.

1. Vocabulary—Gérando collected about a hundred and fifty signs, created by deaf-mutes living in isolation or with their fellows.[1] A few of these may be cited as examples:

*Child*—Infantile gesture, of taking the breast, or being carried, or rocking in the cradle.

*Ox*—Imitation of the horns, or the heavy tread, or the jaws chewing the cud.

*Dog*—Movement of the head in barking.

*Horse*—Movements of the ears, or two figures riding horseback on another, etc.

*Bird*—Imitation of the beak with two fingers of the left hand, while the other feeds it; or simulation of flight.

[1] *De l'Education des sourds-muets*, 2 vol., 1827. Notwithstanding its somewhat remote date, the book has lost none of its interest in this particular. It must also be remembered that institutions for deaf-mutes are far more numerous now than at the beginning of the century, and that the children are placed in them much earlier. Formerly they were abandoned to themselves or instructed very late; in proportion to their age, they presented better material for the study of their development.

*Bread*—Signs of being hungry, of cutting, and of carrying to the mouth.

*Water*—Exhibition of saliva, imitation of a rower, or of a man pumping; accompanied always by the sign of drinking.

*Letter* (missive)—Gestures of writing and of sealing, or of unsealing and reading.

Monkeys, cocks, various trades (carpenter, shoemaker, etc.) all designated by imitative gestures. For sleep, sickness, health, etc., they employ an appropriate gesture.

For interrogation: expression of two contradictory propositions, and undecided glance towards the person addressed. This is rather a case of syntax than of vocabulary; but a few signs may be further indicated for some notions more abstract than the preceding.

*Large*—Raise the hand and look up.

*Small*—Contrary gestures.

*Bad*—Simulate tasting, and make grimace.

*Number*—Indicate with the help of the fingers; *high numbers*, rapid opening of the hand several times in succession.

*Buy*—gesture of counting money, of giving with one hand, and taking with the other.

*Lose*—Pretend to drop an object, and hunt for it in vain.

*Forget*—Pass the hand quickly across the forehead with a shrug of the shoulders.

*Love*—Hold the hand on the heart (universal gesture).

*Hate*—Same gesture with sign of negation.

*Past*—Throw the hand over the shoulder several times in succession.

*Future*—Indicate a distant object with the hand,

repeated imitation of lying down in bed and getting up again.

It does not need much reflexion to see that all these signs are *abstractions* as well as imitations. Among the different characters of an object, the deaf-mute chooses one that he imitates by a gesture, and which represents the total object. Herein he proceeds exactly like the man who speaks. The difference is that he fixes the abstract by an attitude of the body instead of by a word. The primitive Aryan who denominated the horse, the sun, the moon, etc., the rapid one, the shining one, the measurer (of months), did not act otherwise; for him also, a chosen characteristic represents the total object. There is a fundamental identity in the two cases; thus justifying what was said above: abstraction is a *necessary* operation of the mind, at least in man; he must abstract, because he must simplify.

The inferiority of these imitative signs consists in their being often vague, with a tendency to the opposite sense; moreover, since they are never detached completely from the object or the act which they figure, and cannot attain to the independence of the word, they are but very imperfect instruments of substitution.

II. Syntax—The mere fact of the existence of a syntax in the language of the deaf-mutes proves that they possess a commencement of analysis, i. e., that thought does not remain in the rudimentary state. This point has been carefully studied by different authors: Scott, Tylor, Romanes,[1] who assign to it the following characteristics:

[1] Tylor, *Early History of Mankind*, p. 80. Romanes, *Mental Evolution in Man*, Chapter VI.

1. It is a syntax of position. There are no "parts of speech," i. e., terms having a fixed linguistic function: substantive, adjective, verb, etc. The terms (gestures) borrow their grammatical value from the place which they occupy in the series, and the relations between the terms are not expressed.

2. It is a fundamental principle that the signs are disposed in the order of their relative importance, everything superfluous being omitted.

3. The subject is placed before the attribute, the object (complement) before the action, and, most frequently, the modified part before the modifying.

Some examples will serve for the better comprehension of the ordinary procedure of this syntax. To explain the proposition: After running, I went to sleep, the order of gesture would be: to run, me, finished, to sleep.—My father gave me an apple: apple, father, me, give.—The active state is distinguished from the passive by its position: I struck Thomas with a stick; me, Thomas, strike, stick. The Abbé Sicard, on asking a deaf-mute, Who created God? obtained the answer: God created nothing. Though he had no doubt as to the meaning of this inversion, he asked the control question, Who makes shoes? Answer, shoes makes cobbler.

The dry, bare character of this syntax is evident: the terms are juxtaposed without relation; it expresses the strictest necessity only; it is the replica of a sterile, indistinct mode of thought.

Since we are endeavoring by its aid to fix an intellectual level, it is not without interest to compare it with a syntax that is frequent among the weak in intellect. "These do not decline or conjugate; they employ a vague substantive, the infinitive alone, or

the past participle. They leave out articles, conjunctions, auxiliary verbs, reject prepositions, employ nouns instead of pronouns. They call themselves "father," "mother," "Charles," and refer to other people by indeterminate substantives, such as man, woman, sister, doctor, etc. They invert the regular order of substantives and adjectives."[1] Although this is a case of mental regression, hence not rigorously comparable with a mind that is sane but little developed, the mental resemblance between the two syntaxes, and especially the absence of all expression of relations deserves to be signalised, because it cannot be the result of a fortuitous coincidence. It is the work of intellectual inferiority and of relative discontinuity of thought.

There is little to say about *numeration* in deaf-mutes. When untrained, they can count up to ten with the help of their fingers, like many primitive people. Moreover (according to Sicard and Gérando), they make use of notches upon a piece of wood or some other visible mark.

To conclude, their mental feebleness, known since the days of antiquity by Aristotle, by the Roman law which dispossessed them of part of their civil rights, later on by many philosophers who refused even to concede them memory, arises from their inaptitude to transcend the inferior forms of abstraction and kindred operations. In regard to the events of ordinary life, in the domain of the concrete (admitting, as is not always done, that there are individual varieties, some being intelligent, and others stupid), deaf-mutes are sufficiently apt to seize and to comprehend the prac-

[1] Kussmaul, *Die Störungen der Sprache*, Chapter xxx.

tical connexion between complex things.[1] But the world of higher concepts, moral, religious, cosmological, is closed to them. Observations to this effect are abundant, though here again—as must be insisted on—they reveal great individual differences.

Thus, a deaf-mute whose friends had tried to inculcate in him a few religious notions, believed before he came under instruction that the Bible was a book that had been printed in heaven by workmen of Herculean strength. This was the sole interpretation he gave to the gestures of his parents, who endeavored to make him understand that the Bible contains a revelation, coming from an all-powerful God who is in heaven.[2] Another who was taken regularly to church on Sunday, and exhibited exemplary piety, only recognised in this ceremony an act of obedience to the clergy. There are many similar cases on record. Others on the contrary, seek to inquire into, and to penetrate, the nature of things. W. James[3] has published the autobiography of two deaf-mutes who became professors, one at the asylum of Washington, the other in California.

The principal interest attaching to the first is the spontaneous appearance of the moral sense. After stealing small sums of money from the till of a mer-

[1] Cf. as proof, the story related by Kussmaul (*op. cit.*, VII.): A young deaf-mute was arrested by the police of Prague as a vagabond. He was placed in an institution and questioned by suitable methods, when he made known that his father had a mill with a house and surroundings which he described exactly; that his mother and sister were dead, and his father had remarried; that his step-mother had ill-treated him, and that he had planned an escape which had succeeded. He indicated the direction of the mill to the east of Prague. Inquiries were made, and all these statements were verified.

[2] Romanes, *Mental Evolution*, etc., p. 150.

[3] W. James, *Psychology*, I., 266, for the second observation; *Philosophical Review*, I., No. 6, p. 613 et seq. for the first.

chant, he accidentally took a gold coin. Although ignorant of its value, he was seized with scruples, feeling "that it was not for a poor man like him, and that he had stolen *too much*." He got rid of it as best he could, and never began again.

The other biography—from which we make a few brief extracts—may be taken as the type of an intelligent and curious deaf-mute. He was not placed in an institution until he was eleven years old. During his childhood he accompanied his father on long expeditions, and his curiosity was aroused as to the origin of things: of animals and vegetables, of the earth, the sun, the moon, the stars (at eight or nine years). He began to understand (from five years) how children were descended from parents, and how animals were propagated. This may have been the origin of the question he put to himself: whence came the first man, first animal, first plant, etc. He supposed at first that primæval man was born from the trunk of a tree, then rejected this hypothesis as absurd, then sought in various directions without finding. He respected the sun and moon, believed that they went under the earth in the West, and traversed a long tunnel to reappear in the East, etc. One day, on hearing violent peals of thunder, he interrogated his brother, who pointed to the sky, aud simulated the zigzag of the lightning with his finger; whence he concluded for the existence of a celestial giant whose voice was thunder. Puerile as they may be, are these cosmogonic, theological conceptions inferior to those of the aborigines of Oceanica and of the savage regions of South America, who, nevertheless, have a vocal idiom, a rudimentary language?

To sum up. That which dominates among the bet-

ter gifted, is the creative imagination: it is the culminating point of their intellectual development. Their primitive curiosity does not seem inferior to that of average humanity; but since they cannot get beyond representation by images they lack an instrument of intellectual progress.

### ANALYTICAL GESTURES.

The question of signs is so closely allied to our subject—the evolution of general ideas—that we must insist upon the language of gesture as an instrument of analysis, before going on to speech—of which it is an imperfect substitute.

St. George Mivart (*Lessons from Nature*) gives the following as a complete classification of every species of sign, omitting those that are written:

1. Sounds which are neither articulate nor rational, such as cries of pain, or the murmur of a mother to her infant.

2. Sounds which are articulate but not rational, such as the talk of parrots, or of certain idiots, who will repeat, without comprehending, every phrase they hear.

3. Sounds which are rational but not articulate, such as the inarticulate ejaculations by which we sometimes express assent to or dissent from given propositions.

4. Sounds which are both rational and articulate, constituting true "speech."

5. Gestures which do not answer to rational conceptions, but are merely the manifestations of emotions and feelings.

6. Gestures which do answer to rational concep-

tions, and are therefore "external" but not "oral" manifestations of the *verbum mentale.*

This last group, the only one which concerns us for the moment, would to my thinking be conveniently designated by the term *analytic gestures,* as opposed to the synthetic gestures which manifest the different modes of affective life, and constitute what is called the expression of the emotions.

This language of gesture, intellectual and non-emotional, which translates ideas, not sentiments, is more widely distributed than is generally known, among primitive peoples. It has been observed in very distinct regions of our globe; among the aborigines of North and South America, the Bushmen, etc. It is a means of communication between tribes who do not speak the same language; often, indeed, it is an indispensable auxiliary to these indigent idioms. The most important work on this subject is by an American, Col. Mallery, who with indefatigable patience has collected and interpreted the gestures in use among the Indians of North America.[1] This work alone reveals the variety of sign-language, which hardly ever leaves the region of practical life: description of the countries traversed, hints for travellers, directions to be followed, distances, time required for halts, manner, habits, and dispositions of tribes. We may cite a brief quotation, from another author:

"Meeting an Indian, I wish to ask him if he saw six waggons drawn by horned cattle, with three Mexican and three American teamsters, and a man mounted on horseback. I make these signs:

1 *Sign-Language Among the North American Indians,* 1881. Published in Report of the Bureau of Ethnology at Washington. Cf. also: Tylor, *op. cit.:* Romanes, *op. cit.,* VI.; Lubbock, *Origin of Civilisation,* Chapter VI.; Kleinpaul, *Zeitschrift für Völkerpsych.,* VI., 353.

I point 'you,' then to his eyes, meaning 'see'; then hold up all my fingers on the right hand and the forefinger on the left, meaning 'six'; then I make two circles by bringing the ends of my thumbs and forefingers together, and, holding my two hands out, move my wrists in such a way as to indicate waggon-wheels revolving, meaning 'waggons'; then, by making an upward motion with each hand from both sides of my head, I indicate 'horns,' signifying horned cattle; then by first holding up three fingers, and then by placing my extended right hand below my lower lip and moving it downward, stopping it mid way down the chest, I indicate 'beard,' meaning Mexican; and with three fingers again, and passing my right hand from left to right in front of my forehead, I indicate 'white brow' or 'pale face.' I then hold up my forefinger, meaning one man, and by placing the forefinger of my left hand between the fore and second finger of my right hand, representing a man astride of a horse, and by moving my hands up and down, give the motion of a horse galloping with a man on his back. I in this way ask the Indian, 'You see six waggons, horned cattle, three Mexicans, three Americans, one man on horseback?' . . . . . The time required to make these signs would be about the same as if you asked the question verbally."[1]

Tylor says that the language of gestures is substantially the same all the world over, and this assertion is confirmed by all who have practised and studied it. Its syntax resembles that of deaf-mutes, and it is unnecessary to repeat it. The parable of the Prodigal Son was translated by Mallery into analytic gestures; and from this language translated afresh into the spoken tongue: "Formerly, man one, sons two," etc., etc. The comparison of the two texts is instructive: in the one, the thought unfolds itself by a movement of complete analysis with relations and shades of meaning: in the other, it resembles a line of badly quarried blocks, put together without cement.

[1] Lubbock, *The Origin of Civilisation and the Primitive Condition of Man*, p. 417.

After what has already been said, there is nothing surprising in finding a fundamental analogy, or even identity, between the language of deaf-mutes and the analytic gestures of primitive peoples. It was indeed pointed out by Akerly in an institution in New York in the beginning of the century. Gérando gave a good many examples,[1] remarking that the "gestures of reduction," i. e., abridged gestures, are often enough identical in the two cases. Mallery brought together some Utah Indians, and a deaf-mute, who gave them a long account of a marauding expedition, followed by a dialogue: they understood each other perfectly.

The language of analytical gesture is thus a substitute for spoken language, and this leads us to a question which, though purely speculative, deserves our attention for a moment.

At a time when it was almost universally admitted that man is unable to think without words, Dugald Stewart ventured to write: "If men had been deprived of the organs of voice or the sense of hearing, there is no doubt that they would have invented an alphabet of visible signs wherewith to express all their ideas and sentiments."[2] This is no rash assertion; we have just seen proofs of it. But is this pantomime-language susceptible of progress?

We can hardly doubt that if humanity, with its proper cerebral constitution, had at the same time been unable to speak, the language of analytic gesture would, by the initiative of certain inventors, under press of necessity, and by the influence of co-operation and of life in common, have advanced beyond

[1] Gérando, *op. cit.*, II., note K, p. 203. Among the gestures that are identical under their double form may be noted stone, water, large, tall, to see, finished, man, house, good, pretty, now, etc.

[2] *Philosophy of the Human Mind*, Ch. I., sect. 2.

the imperfect phase at which it has remained; and no one can say what it might have become in the accumulated effort of centuries. Speech, too, had to traverse an embryonic period, and oral language developed slowly and painfully. At the same time it is an exaggeration to say that "phonetic language assumed its extraordinary importance almost by chance, and that we cannot doubt that the language of mimicry, had it been fashioned by social relations during secular ages, would be hardly inferior to speech in force, facility, and variety."[1] In fact, man had originally two languages at his disposal; he used the one and the other interchangeably and simultaneously. They helped each other in the development of ideas that were as yet chaotic and vacillating. Under these conditions, speech prevailed; the language of gesture remained only as a survival or a substitute. There is nothing fortuitous in this: speech has won because of its greater value.

First, for *practical* reasons. And this is the capital factor, since the main point is to communicate with one's fellow-men. The language of gesture—besides monopolising the hands, and thus keeping them from other work—has the great disadvantage of not carrying far, and of being impossible in the dark. To this we may add the reasons cited above: its vague character, and (with regard to the abstract) its imitative nature, which forbids emancipation, or complete detachment, from the concrete, or the translation of that which cannot be represented. It is to be remarked, however, that the invention of "reduced" signs seems to be a transition from pure imitation to symbolism, a first step in the path of emancipation.

[1] Kleinpaul, *loc. cit.*

Speech, on the contrary, is transmitted to a distance, and challenges darkness. It is dependent upon the ear, an organ whose sensations are infinite in number and kind; and in the finest expression of ideas and of feelings, language participates in this opulence. It lends itself to variety, delicacy, to an extreme complexity of movement in a small space, with very little effort. We are, for the moment, citing physiological reasons only. But these will suffice to show that the triumph of speech has not been fortuitous, but that it is a very special case of natural supremacy.[1]

In conclusion, there is nothing to add as to generic images, and the logic of images. The important part which they play amongst children and deaf-mutes testifies to their extension and importance as inferior forms of abstraction, without in any way altering their essential nature, as previously determined.

[1] Writing, ideography, originated in an analytical process analogous with the language of gestures. Like the latter, it (1) isolates terms, (2) arranges them in a certain order, (3) translates thought in a crude and somewhat vague form. Curious examples of this may be found in Max Müller's *Chips from a German Workshop*, XIV. The aborigines of the Caroline Islands sent a letter to a Spanish captain, as follows: Above, a man with extended arms, sign of greeting. Below, to the left, the objects he has to offer; five big shells, seven little ones, three others of different forms. To the right and centre, drawing of the objects wanted in exchange: three large fish hooks, four small ones, two axes, and two pieces of iron.

# CHAPTER II.

## SPEECH.

BEFORE we inquire into abstraction, as fixed and expressed in words,—whether such words are the complement of an actual or possible representation, or exist alone in consciousness, as complete substitutes,—it is indispensable that we should study the origin, and still more the evolution, of this new factor. Although many linguists resolutely abstain from considering the origin of speech (which is certainly, like all other genetic problems, beyond the grasp of psychology), the question is so intimately allied with that of the evolution of articulate language, allied again in itself with the progressive development of abstraction and of generalisation, that we should not be justified in withholding a brief summary of the principal hypotheses relating to this subject, while limiting ourselves to the most recent.

### I.

Launching forth then into this region of conjecture—do we, in the first place, find among some animals, signs and means of communication which for them are the equivalents of language? In considering this point it matters little whether or no we accept

the evolutionary thesis. It must not be forgotten, in fact, that the problem of the origin of speech is only a particular case of the origin of language in general: speech being but one species among several others of the *facultas signatrix*, which can only be manifested in the lower animals in its humblest form.

There can be no doubt that pain, joy, love, impatience, and other emotional states are translated by proper signs, easy to determine. Our problem, however, is different; we are concerned with signs of the *intellectual*, not of the affective, life. In other words, can certain animals transmit a warning, or an order, to their fellows? Can they muster them for a co-operative act, and make themselves intelligible? Although the interpretation is necessarily open to the suspicion of anthropomorphism, it is difficult not to recognise a sort of language in certain acts of animal life. Is it *a priori* probable that animals, which form stable and well-organised societies, should be bereft of all means of intercommunication and comprehension?

With regard to ants, we learn from such observers as Kirby and Spence, Huber, Franklin, that they employ a system of signs. To elucidate this point, Lubbock undertook a series of patient experiments, certain of which may be quoted.[1] He pinned down a dead fly so that no ant could carry it off. The first that came made vain attempts to remove it. It then went to the ant-hill and brought seven others to the rescue, but hurried imprudently in front of them. "Seemingly only half awake," they lost the track and wandered alone for twenty minutes. The first returned to the nest and brought back eight, who, so

[1] *Ants, Bees, and Wasps*, VII.—Romanes, *Animal Intelligence*, IV.

soon as they were left behind by the guide, turned back again. During this time the band of seven (or at least some of them) had discovered the fly, which they tore in pieces and carried off to the nest. The experiment was several times repeated, with different species, and always with the same result. Lubbock concluded that ants were able to communicate their discoveries, but without indicating locality. In another experiment he placed three glasses at a distance of thirty inches from a nest of ants. One of the glasses contained two or three larvæ, the second three hundred to six hundred, the third none at all. He connected the nest with the glasses by means of three parallel tapes, and placed one ant in the glass with many larvæ and another ant in that with two or three. Each of them took a larva and carried it to the nest, returning for another, and so on. After each journey he put another larva into the glass with only two or three larvæ, to replace that which had been removed, and every stranger brought was imprisoned until the end of the experiment. Were the number of visits to all three glasses the same? And if not, which of the two glasses containing larvæ received the greater number of visitors? A difference in number would seem to be conclusive as proving power of communication. The result was that during forty-seven and a half hours two hundred and fifty-seven friends were brought by the ants having access to the glass containing numerous larvæ, while during an interval of fifty-three hours there were only eighty strange visitors to the glass containing two or three larvæ; there were no visits to the glass containing none. Communication for bees as for ants, appears to be made by rubbing the antennæ. If the queen is carried off in a hive,

some of the bees are sure to discover it before long. They become greatly agitated, and run about the hive frantically, touching any companions they meet with their crossed antennæ, and thus spreading the news through the whole community. The bee-hunters in America discover them by choosing a clearing where they catch a few wandering bees, which are then gorged with honey and suffered to fly when replete. These bees return with a numerous escort. The same process is repeated with the new comers, and by observing the direction which they follow at their departure, the nest is discovered.

As regards the higher animals, the truth (notwithstanding the exaggerations of G. Leroy—who asserts that when they hunt together, wait for one another, find each other again, and give mutual aid, "these operations would be impossible without conventions that could only be communicated in detail by means of an articulate language [*sic*]") is that we know singularly little about them. It is certain that, in addition to sounds that translate their emotions, many species have other means of communication. According to Romanes[1] the more intelligent dogs have the faculty of communicating with one another, by the tone of barking, or by gesture, such simple ideas as "follow me." This gesture is invariably the same; being a contact of heads with a motion between a rub and a butt, and always resulting in a definite but never complex course of action. In a troop of reindeer the leader makes one sign for the halt, another for the march forward, hitting the laggards one after another with his horns. Monkeys are known to produce various sounds (the gibbon compasses a complete octave), and several

[1] *Animal Intelligence*, XVI., p. 445.

species will meet and hold a kind of conversation. Unfortunately, notwithstanding recent researches, we have only vague and doubtful data in regard to monkey language.

We know finally, that certain birds are able to articulate, and possess all the material conditions of speech, the faculty being indeed by no means uncommon. Parrots do even more; there is no doubt that they can apply words, parts of sentences, and airs, to persons, things, or definite events, without varying the application, which is always the same.[1] Association by contiguity sufficiently explains this fact, but, granting that they do not as a rule make a right intellectual use of articulate sounds, they seem in certain instances to attach to them the value of a *sign*. Romanes actually observed a more extraordinary case, implying generalisation, with apposition of a sound. In the first instance, one of his parrots imitated the barking of a terrier which lived in the house. Later on, this barking became a denotative sound, the proper name of the dog; for the bird barked as soon as it saw the terrier. Finally, at a still later stage, it got into the habit of barking when any dog, known or unknown, came into the house; but ceased to bark at the terrier. While distinguishing individuals it therefore perceived their resemblance. "The parrot's name for an individual dog became extended into a generic name for all dogs."[2]

In short, the language of animals—so far as we know it—exhibits a very rudimentary development, by no means proportionate to that of the logic of im-

[1] The most interesting of the many observations on this subject are those of Dr. Wilks, F. R. S., published in the *Journal of Mental Science*, July, 1879.

[2] *Mental Evolution in Man*, p. 137.

ages, and highly inferior to that of analytical gesture. It throws no light, notwithstanding all that has been said, upon the problem of the origin of speech.

In respect to this subject, which has excited human curiosity for centuries without satiation, there appear to me (when we have eliminated old or abandoned hypotheses) to be only two theories which have any solidity: the one presupposes instinct; the other a slow evolution.

I. It must be remarked that if the partisans of the first theory seem at the outset to have frankly admitted innate disposition (the fundamental characteristic of instinct), it is more difficult to distinguish between some of the later writers and the evolutionists.

Thus it has been said: speech is a necessary product in which neither reflexion nor will participate, and which is derived from a secret instinct in man (Heyse). Renan sustained a similar thesis. For Max Müller, "man is born speaking, as he is born thinking"; speech marks the transition from (concrete) intuitions to ideas; it is a fact in the development of the mind; it is created with no distinct consciousness of means and end." For Steinthal, on the contrary, "language is neither an invention nor an innate product; man creates it himself, but it is not begotten of the reflecting mind." Through all these formulæ, and others somewhat tinged with mysticism, we can discover but one point of fact, analogous to that which states that it is in the nature of the bee to form its comb, of the spider to weave its web. The last word of the enigma is unconscious activity, and whether directly, or by evasions, this school must return to innate faculties.

A somewhat recent theory,—that of L. Noiré,[1]—is distinct from the foregoing. In these, speech is the direct (although, it is true, unconscious) expression of intelligence; for Noiré, on the other hand, it is the outcome of will. "Language is the result of *association*, of community of feeling, of a sympathetic activity which, at the outset, was accompanied by sounds . . . . ; it is the child of *will* and not of sensation." Speech is derived from community of action, from the collaboration of primitive men, from the common use of their activities. When our muscles are in action, we feel it a relief to utter sounds. The men who work together, the peasants who dig or thresh the grain, sailors rowing, soldiers marching, emit more or less vibrant articulations, sounds, exclamations, humming, songs, etc. These sounds present the requisite characters of the constitution of articulate language; they are common to all; they are intelligible, being associated by all with the same acts. Action, according to Noiré, is the primitive element in all language. Human labor is the content of primitive roots; to cut, knock, dig, hollow, weave, row, etc. Although Max Müller adhered almost unreservedly to this hypothesis, it has, like all others, encountered much criticism which we need not dwell on. Is it probable, it has been asked, that the first names should have been for acts only, not for objects? How explain the synonyms and homonyms so frequent in primitive language? etc.

II. The hypothesis of a progressive evolution of speech, while dating from antiquity, has only taken a consistent form in our own days, under the influence of transformist doctrines. The work of anthropolo-

[1] *Der Ursprung der Sprache* (1877). Fr. Müller maintained a similar view.

gists and of linguists, above all of the former, it finds support in the study of inferior idioms and of the comparative method. Its fundamental thesis is that articulate language is the result of a long elaboration, lasting for centuries, in which we may with some probability reconstitute the stages. While its authors are not in complete agreement it may be said that, generally speaking, they admit three periods: the cry, vocalisation, articulation.

The cry is the primordial fact, the pure animal language, a simple vocal aspiration, without articulation. It is either reflex, expressing needs and emotions, or, at a stage higher, intentional (to call, warn, menace, etc.). It has been said that the speechlessness of animals is due to the imperfection of their auditory [?] organs, and want of organic correspondence between their acoustic images and the muscular movements that produce sound: but the cause of this aphasia must also, and above all, be referred to their weak cerebral development; this applies also to primitive man. "What function could words have fulfilled when the anthropoid of the Neanderthal or the Naulette roamed, naked and solitary, from ditch to ditch, through the thick atmosphere, over marshy soil, stone in hand, seeking edible plants or berries, or the trail of females as savage as himself?"[1] It is intelligence that creates its instruments, as well speech as all the rest.

Vocalisation (emission of vowels only) does not in itself contain the essential elements of speech. Many animals practise it; our vowels, long or short, even our diphthongs, can readily be recognised in the voice

[1] A. Lefèvre, *Les races et les langues* (*Bibliothèque scientifique internationale*), pp. 5-6.

of different species (dog, cat, horse, birds in large numbers, etc.). In the child, it succeeds the period of the simple cry; and since it is admitted that the development of the individual hints at that of the race; that, moreover, many primitive languages or rudimentary idioms (as such, near the time of their origin) are very rich in vowels,—it has been concluded that there existed a longer or shorter period intermediate between those of the cry and of articulation (this thesis has close affinities with the theory of Darwin, Spencer, etc., which has been rejected by other evolutionists); that speech is derived from song, intellectual language from emotional language; in other words, that man could sing before he could speak. Various facts are alleged in support of this theory: (1) In monosyllabic languages, which are generally held to be the most ancient, the accent plays a cardinal rôle; the same syllable, according to the tone which accompanies it, takes on the most widely different meanings. Such is the case of the Chinese. In Siamese, *hă* = to seek; *hà* = plague; *hâ* = five. (2) Other languages in which intonation is of less importance, are nevertheless in close relation with song, and by reason of their vocabulary and of the grammatical construction, modulation is necessary for giving a complete sense to the words and phrases. (3) Even in our own languages, which are completely dissociated from song, the voice is not even in tone; it can be greatly modified according to circumstances. Helmholtz showed that for such banal phrases as "I have been for a walk," "Have you been for a walk?" the voice drops a quarter-tone for the affirmation, and rises a fifth for the interrogation. H. Spencer called attention to several facts of the same order, all com-

monplace. (4) The impassioned language of emotion resembles song: the voice returns to its original form; "it tends," according to Darwin, "to assume a musical character, in virtue of the principle of association."

Whatever may be the force of this reasoning, conclusive for some, doubtful for others, the conditions necessary to the existence of speech arose with articulation only, consonants being its firmest element. The origin of speech has been much disputed. Romanes invokes natural selection: "The first articulation probably consisted in nothing further than a semiotic breaking of vocal tones, in a manner resembling that which still occurs in the so-called 'chattering' of monkeys,—the natural language for the expression of their mental states."[1] It should, however, be noted that the question, under this form, has merely a physiological interest. The voice is as natural to man as are the movements of his limbs; between simple voice and articulate voice there is but the same distance as between the irregular movements of the limbs of the newly born, and such well-co-ordinated movements as walking. Articulation is merely one of the forms of expression: it is so little *human* that it is met with, as we have seen, among many of the lower animals. The true *psychological* problem lies elsewhere: in the employment of articulate sounds as *objective signs*, and the attaching of these to objects with which they are related by no natural tie.

Geiger in his *Ursprung der Sprache* (1878) brought forward a hypothesis which has been sustained by other authors. It may be summed up as follows: words are an imitation of the movements of the

[1] *Loc. cit.*, 372.

mouth. The predominant sense in man is that of sight; man is pre-eminently visual. Prior to the acquisition of speech, he communicated with his fellows by the aid of gestures, and movements of the mouth and face; he appealed to their eyes. Their facial "grimaces," fulfilled and elucidated by gesture, became signs for others; they fixed their attention on them. When articulate sounds came into being, these lent themselves to a more or less conventional language by reason of their acquired importance. For support of this hypothesis, we are referred to the case of non-educated deaf-mutes. These invent articulate sounds (which of course they cannot hear), and use them to designate certain things. While many of these words appear to be an arbitrary creation (e. g., *ga* = one, *ricke* = I will not, etc.), others result from the imitation by their mouth of the movements perceived on the mouth of others. Such are *mumm* = to eat; *chipp* = to drink; *be-yr* = barking of a dog, etc.[1] Why should primitive man have done less than the deaf-mute, when he not only saw the movements but heard the sounds to boot?

To conclude with a subject in which individual hypotheses abound, and which for us is only of indirect interest, we may summarise the sketch given recently enough (1888) by one of the principal partisans of the evolutionary theory:

"Starting from the highly intelligent and social species of anthropoid ape as pictured by Darwin, we can imagine that this animal was accustomed to use its voice freely for the expression of its emotions, uttering of danger-signals, and singing. Possibly enough also it may have been sufficiently intelligent

[1] Heinicke, *Beobachtungen über Stumme*, 75, 137.

to use a few imitative sounds; and certainly sooner or later the receptual life of this social animal must have advanced far enough to have become comparable with that of an infant at about two years of age. That is to say, this animal, although not yet having begun to use articulate signs, must have advanced far enough in the conventional use of natural signs (or signs with a natural origin in tone and gesture, whether spontaneous only or intentionally imitative) to have admitted of a tolerably free exchange of receptual ideas, such as would be concerned in animal wants, and even, perhaps, in the simplest forms of co-operative action. Next, I think it probable that the advance of receptual intelligence which would have been occasioned by this advance in sign-making, would in turn have led to a further development of the latter, —the two thus acting and reacting on each other until the language of tone and gesture became gradually raised to the level of imperfect pantomime, as in children before they begin to use words. At this stage, however, or even before it, I think very probably vowel-sounds must have been employed in tone-language, if not also a few of the consonants. Eventually the action and reaction of receptual intelligence and conventional sign-making must have ended in so far developing the former as to have admitted of the breaking up (or articulation) of vocal sounds, as the only direction in which any further improvement of vocal sign-making was possible. I think it not improbable that this important stage in the development of speech was greatly assisted by the already existing habit of articulating musical notes, supposing our progenitors to have resembled the gibbons or the chimpanzees in this respect. But long after this first

rude beginning of articulate speech, the language of tone and gesture would have continued as much the most important machinery of communication. Even if we were able to strike in again upon the history thousands of years later, we should find that pantomime had been superseded by speech. I believe it was an inconceivably long time before this faculty of articulate sign-making had developed sufficiently far to begin to starve out the more primitive and natural systems; and I believe that, even after this starving-out process did begin, another inconceivable lapse of time must have been required for such progress to have eventually transformed *Homo alalus* into *Homo sapiens.*"[1]

Among all these hypotheses we may choose or not choose; and while we have dwelt briefly on this debated problem, whose literature is copious, we may yet have said too much on what is mere conjecture.

One certain fact remains, that—notwithstanding the theory by which speech is likened to an instinct breaking forth spontaneously in man—it was at its origin so weak, so inadequate and poor, that it perforce leaned upon the language of gesture to become intelligible. Specimens of this mixed language are still surviving among inferior races that have nothing in common between them, inhabiting regions of the earth with no common resemblances.

In some cases speech coexists with the language of action (Tasmanians, Greenlanders, savage tribes of Brazil, Grebos of Western Africa, etc.). Gesture is here indispensable for giving precision to the vocal sounds; it may even modify the sense. Thus, in one of these idioms, *ni ne* signifies "I do it," or "You do

[1] Romanes, *Mental Evolution in Man*, pp. 377–379.

it," according to the gesture of the speaker. The Bushman vocabulary is so incomplete and has to be reinforced by so many mimic signs, that it cannot be understood in the dark. In order to converse at night, the tribe is obliged to gather round the fire.

In other cases, speech coexists with inarticulate sounds (Fuegians, Hottentots, certain tribes of North America) which travellers have compared, respectively, to clinking and clapping. These sounds have been classified according to the physiological process by which they are produced, into four (or even six) species: dental, palatal, cerebral, lateral; it is impossible to translate them by an articulated equivalent. "Their clappings survive," says Sayce, "as though to show us how man, when deprived of speech, can fix and transmit his thought by certain sounds." Among the Gallas, the orator haranguing the assembly marks the punctuation of his discourse by cracking a leather thong. The blow, according to its force, indicates a comma, semi-colon, or stop; a violent blow makes an exclamation.[1]

It was advisable to recall these mixed states in which articulate language had not yet left its primitive vein. They are transitional forms between pure pantomime and the moment when speech conquered its complete independence.

II.

In passing from the origin of speech to the study of its development, we enter upon firmer ground. Although this development has not occurred uniformly in every race, and the linguists—who are here our

[1] For documents, consult especially Tylor, *Primitive Culture*, V; Sayce *Principles of Comparative Philology*, I., § 17.

guides—do not always agree in fixing its phases, it is nevertheless the surest indication of the march of the human mind in its self-analysis in passing from extreme confusion to deliberate differentiation; while the materials are sufficiently abundant to admit of an objective study of intellectual psychogenesis, based upon language.

This attempt has nothing in common with the "general or philosophical grammar" of the beginning of this century. The Idealogues who founded this had the pretension, while taking language as their basis, to analyse the fundamental categories of intelligence: substance, quality, action, relation. A laudable enterprise, but one which, by reason of the method employed, could only be abortive. Knowing only the classical or modern languages, the products of a long civilisation, they had no suspicion of the embryonic phases; accordingly, they made a theoretical construction, the work of logicians rather than of psychologists. Any positive genetic investigation was inaccessible to them; they were lacking in material, and in instruments. If by a comparison borrowed from geology, the adult languages are assimilated to the quaternary layer; the tertiary, secondary, and primary strata will correspond with certain idioms of less and less complexity, which themselves contain the fossils of psychology. These lower forms—the semi-organised or savage languages which are a hundred times more numerous than the civilised languages—are now familiar to us; hence there is an immense field for research and comparison. This retrogression to the primitive leads to a point that several linguists have designated by a term borrowed from biology: it is the protoplasmic state "without

functions of grammatical categories" (Hermann Paul). How is it that speech issued from this undifferentiated state, and constituted little by little its organs and functions? This question is interesting to the linguist on certain sides, to the psychologist on others. For us it consists in seeking how the human mind, through long groping, conquered and perfected its instrument of analysis.

I. At the outset of this evolution, which we are to follow step by step, we find the hypothesis of a primitive period, that of the *roots* so called, and it is worth our while to pause over this a little. Roots—whatever may be our opinion as to their origin—are in effect general terms. But in what sense?

Chinese consists of 500 monosyllables which, thanks to varieties of intonation, sufficed for the construction of the spoken language; Hebrew, according to Renan, has about 500 roots; for Sanskrit there is no agreement. According to a bold hypothesis of Max Müller, it is reducible to 121, perhaps less, and "these few seeds have produced the enormous intellectual vegetation that has covered the soil of India from the most distant antiquity to the present day."[1] Whatever their number may be, the question for us reduces itself into knowing their primitive intellectual content, their psychological value. Here we are confronted by two very different theses. For one camp, roots are a reality; for the other, they are the simple residuum of analysis.

"Roots are the phonetic types produced by a force inherent in the human mind; they were created by nature," etc., etc. Thus speaks Max Müller. Whitney, who is rarely of the same mind, says, notwithstanding,

[1] This list may be found in *The Science of Thought*, p. 406.

that all the Indo-European languages are descended from one primitive, monosyllabic language, "that our ancestors talked with one another in simple syllables indicative of ideas of prime importance, but wanting all designation of their relations."

In the other camp it is sustained that roots are the result of learned analysis, but that there is nothing to prove that they really existed (Sayce); that they are reconstructed by comparison and generalisation; that, e. g., in the Aryan languages, roots bear much the same relation to Sanskrit, Greek, and Latin words as Platonic ideas to the objects of the real world" (Bréal). It has been calculated that the number of articulate sounds which the human voice is capable of producing amounts to three hundred and eighty-five. These sounds, for physiological reasons, constitute a fundamental theme in the various words created by man. Later on, linguists in comparing the vocables used in different languages, established the frequent recurrence of certain sounds common to several words. These have been isolated, but we must not see in them aught besides *extracts*. Moreover, "the first stammerings of man have nothing in common with phonetic types so arrested in form and abstract in signification, as *dhâ*, to place, *vid*, to see, *man*, to think, and other analogous words."

To sum up. In the first thesis roots come into existence, *ab initio;* words are derived from them by reduplication, flexions, affixes, suffixes, etc.; they are the trunk upon which a whole swarm of languages has proliferated.

In the second thesis, words come first; then the common element disengaged by analysis, but which

never existed as such in the pure and primitive condition.

Whether the one opinion or the other be adopted, I see no conclusion to be drawn from it save that the first terms designated qualities or manners of being, varying with the race. The first thesis seems the more apt in revealing to us the primitive forms of abstraction and generalisation. If it be selected despite its fragility, one finds in the list of roots (even when most reduced) an extraordinary mixture of terms applied to the most disparate things (e. g., tears, break, measure, milk, to choose, to clean, to vomit, cold, to fear, etc.). To assert with Max Müller (from whom I borrow the preceding terms) that "these are the one hundred and twenty-one original concepts, the primitive intellectual baggage of the Aryan family" is to employ an unfortunate formula, for nothing could less resemble concepts than the contents of this list. If the second thesis be adopted, the root then being nothing but "the exposed kernel of a family of words," "a phonogram," analogous to composite photographs, formed like these by a condensation of the similarities between several terms, then clearly primitive abstraction and generalisation must be sought in words, and not in roots.[1]

[1] How were primitive terms (roots or words) formed? A much-debated and still unsolved question. Man had at his disposal one primary element, the interjection. By all accounts this remained sterile, unfertile; it did not give birth to words; it remained in articulate language as a mark of its emotional origin. A second proceeding was that of imitation with the aid of sound, onomatopœia. From antiquity to the present time, it has been regarded as the parent, *par excellence*. This was accepted by Renan, Whitney, Tylor, H. Paul, etc.; rejected by M. Müller, Bréal, P. Regnaud, etc. No one disputes the formation of many words by onomatopœia, but those who question its value as a universal process say that "if in certain sounds of our idioms we seem to hear an imitation of the sounds of nature, we must recollect that the same noises are represented by quite different sounds in other languages, which are also held by those who utter them to be onomatopœia.

II. Leaving this question which, from its relation to that of the origin of speech, shares in the same obscurity, we have further to ask if the primitive terms (whatever nature be attributed to them) were, properly speaking, words or phrases? Did man initially give utterance to simple denominations, or to affirmations and negations? On this point all linguists seem to be in agreement. "Speech must express a judgment." In other words it is always a phrase. "Language is based on the phrase, not on the single word: we do not think by means of words, but by means of phrases."[1]

This phrase may be a single word,—or composite, formed by confusion of words as in the so-called agglutinative, polysynthetic, holophrastic languages,—or two words, subject and attribute; or three distinct words, subject, attribute, and copula; but beneath all these forms the fundamental function is unalterably to affirm or deny.

The same remark has been made of children. "We must," says Preyer, "reject the general notion that children first employ substantives, and afterwards verbs. My son, at the age of twenty-three months first used an adjective to express a judgment, the first which he enunciated in his maternal tongue; he said

Thus it would be more just to say that we hear the sounds of nature through the words to which our ear has been accustomed from infancy" (Bréal). I have observed that those who study the spontaneous formation of language in children, claim for them but little onomatopœism. On the other hand, a word created by undoubted onomatopœia is sometimes by means of association, or of strange analogies, transferred successively to so many objects that all trace of the transformations of meaning may be lost, and the imitative origin actually denied. Such was Darwin's case, cited above, where the onomatopœia of the duck finally served to designate all liquids, all that flies, all pieces of money. If the successive extensions of the term had not been observed, who could have recovered its origin?

[1] Sayce, *loc. cit.*, IV., §§ 3–5.

*heiss* (hot) for 'the milk is too warm.' Later on, the proposition was made in two words: *heim-mimi*, 'I want to go home and drink some milk' (*heim*=home, *mimi*=milk). Taine and others have cited several observations of the same order.[1]

According to some authors, all language that has reached complete development has perforce passed through the three successive periods of monosyllabism, polysynthetism, and analysis; so that the idioms that remain monosyllabic or agglutinative would correspond to an arrest in development. To others, this is a hypothesis, only, to be rejected. However this may be (and it is not a question that we need to examine), it seems rash to assert, with Sayce, "that the division of the phrase into two parts, subject and predicate, is a pure accident, and that if Aristotle had been Mexican (the Aztec language was polysynthetic), his system of logic would have assumed a totally different form." The appearance and evolution of analytical language is not pure accident, but the result of mental development. It is impossible to pass from synthesis to analysis without dividing, separating, and arraying the isolated parts in a certain order. The logic of a Mexican Aristotle might have differed from our own in its form; but it could not have constituted itself without fracture of its linguistic mould, without setting up a division, at least in theory, between the elements of the discourse. The unconscious activity by which certain idioms made towards analysis, and passed from the period of envelopment to that of de-

[1] We cannot doubt, however, that there is in the child (and so too for primitive man) a period of pure and simple denomination, when, in the face of perceived objects, he utters a word, as a spontaneous action, a reflex, with no understood affirmation. But this act is rather the prelude, and attempt at speech, an advance towards language proper.

velopment, imposed upon them a successive order. Polysynthetic languages have been likened to the performance of children who want to say everything at once, their ideas all surge up together and form a conglomeration.[1] Evidently this method must be given up, or we must renounce all serious progress in analysis.

To sum up the psychological value of the phrase, independently of its multiple forms, we may conclude by the following remarks of Max Müller:

"We imagine that language is impossible without sentences, and that sentences are impossible without the copula. This view is both right and wrong. If we mean by sentence an utterance consisting of several words, and a subject, and a predicate, and a copula, it is wrong. . . . When the sentence consists only of subject and predicate, we may say that a copula is understood, but the truth is that at first it was not expressed, it was not required to be expressed; in primitive languages it was simply impossible to express it. To be able to say *vir est bonus*, instead of *vir bonus*, is one of the latest achievements of human speech."[2]

### III.

The evolution of speech, starting from the protoplasmic state without organs or functions, and acquiring them little by little, proceeding progressively from indefinite to definite, from fluid to fixed state, can only be sketched in free outline. In details it falls

[1] There is in Iroquois a word that signifies, "I demand money from those who have come to buy garments from me." Esquimaux is equally rich in terms of this sort. Yet we must recognise that these immense composite words, themselves formed from abbreviated and fused words, virtually imply the beginning of decomposition.

[2] *Lectures on the Origin and Growth of Religion*, ed. 1891, p. 196.

within neither our subject nor our cognisance. But the successive points of this differentiation, which creates grammatical forms, and parts of discourse, are under an objective form the history of the development of intelligence, inasmuch as it abstracts, generalises, analyses, and tends towards an ever-growing precision. The completely developed languages—and we are speaking only of such—bear throughout the print of the unconscious labor that has fashioned them for centuries: they are a petrified psychology.

We must return to the roots or primitive terms, whatever may be their nature. Two distinct categories are generally admitted: pronominal or demonstrative roots, verbal or predicative roots.

The first form a small group that properly indicate rather the relative position of the speaker, than any concrete quality. They are equivalent to here, there, this, that, etc. They are few in number, and very simple in their phonetic relations: a vowel or vowel followed by a consonant. Many linguists refuse to admit them as roots, and think they have dropped from the second class by attenuation of meaning.[1] Possibly they are a survival of gesture language.

The second (verbal or predicative) is the only class that interests us. These have swarmed in abundance. They indicate qualities or actions; that is the important point. The first words denominated attributes or modes of being; they were adjectives, at least in the measure in which a fixed and rigid terminology can be applied to states in process of forming. Primitive man was everywhere struck with the qualities of things, *ergo* words were all originally appella-

[1] Whitney, *The Life and Growth of Language*, Chap. X. Sayce, *op. cit.*, VI., 28, rejects them absolutely.

tive. They expressed one of the numerous characteristics of each object; they translated a spontaneous and natural *abstraction*: another proof of the precocious and indispensable nature of this operation. From its earliest developments intelligence has tended to simplify, to substitute the part for the whole. The unconscious choice of one attribute among many others depends on various causes; doubtless on its predominance, but above all on the interest it has for man. "A people," remarks Renan, "have usually many words for what most interests them." Thus, in Hebrew, we find 25 synonyms for the observance of the law; 14 for faith in God; 11 for rain, etc. In Arabic, the lion has 500 names, the serpent 200, money more than 80; the camel has 5,744, the sword 1,000 as befits a warrior race. The Lapp whose language is so poor, has more than 30 words to designate the reindeer, an animal indispensable to his life.[1] These so-called synonyms each denominate a particular aspect of things; they witness to the abundance of primitive abstractions.

This apparent wealth soon becomes an embarrassment and an encumbrance. Instead of 100 distinct terms, one generic substantive, plus one or two epithets, would suffice. But the *substantive* was not born of the deliberate desire to obviate this inconvenience. It is a specialisation, a limitation of the primitive meaning. Little by little the adjective lost its qualificative value, to become the name of one of the objects qualified. Thus in Sanskrit *dêva* (shining) finally signified the god; *sourya* (the dazzling) became the sun; *akva* (rapid) the name of a horse, etc. This metamorphosis of adjective into substantive by a speciali-

[1] Renan, *Histoire générale des langues sémitiques*, pp. 128 and 363.

sation of the general sense occurs even in our actual languages; as, e. g., when we say in French *un brilliant* (diamond); *le volant* (of a machine); *un bon* (of bread, counting-house, bank, etc.). What is only an accident now was originally a constant process.[1] Thus the substantive was derived from the primitive adjective; or rather, within the primitive organism, adjective-substantive, a division has been produced, and two grammatical functions constituted.

Many other remarks could be made on the determination of the substantive by inflexions, declensions, the mark of the gender (masculine, feminine, neuter); I shall confine myself to what concerns *number*, since we are proposing to consider numeration under all its aspects. Nothing appears more natural and clear-cut than the distinction between one and several; as soon as we exceed pure unity, the mother of numbers, plurality appears to us to be homogeneous in all its degrees. It has not been so from the beginning. This is proved by the existence of the dual in an enormous number of languages: Aryan, Semitic, Turanian, Hottentot, Australian, etc. One, two, were counted with precision; the rest was vague. According to Sayce, the word "three" in Aryan language at first signified "what goes beyond." It has been supposed that the dual was at first applied to the paired parts of the body: the eyes, the arms, the legs. Intellectual progress caused it to fall into disuse.

At the close of the period of first formation which

[1] We can see how little the *real* order of evolution resembles the theoretical order of the XVIII. century, evolved from pure reasoning: "The complex notions of substances were the *first* known, since they came from the senses, and must therefore have been the first to have names" (Condillac). "With regard to adjectives, the notion must have developed with *exceeding difficulty*, since every adjective is an abstract term, and abstraction is a painful, or unnatural operation" (J. J. Rousseau).

we have been considering, the sentence was only a defaced organism reproduced by one of the following forms: (1) that; (2) that shining; (3) that sun, that shining.[1] The verb is still absent.

With it we enter on the period of secondary formation. It was long held to be an indisputable dogma that the *verb* is the word *par excellence* (*verbum*), the necessary and exclusive instrument of an affirmation. Yet there are many inferior idioms which dispense with it, and express affirmation by crude, roundabout processes, with no precision,—most frequently by a juxtaposition: snow white = the snow is white; drink me wine = I drink (or shall drink) wine, etc. Plenty of examples can be found in special works.

In fact, the Indo-European verb is, by origin, an adjective (or substantive) modified by a pronoun: *Bharâmi* = carrier-me, I carry. It is to be regretted that we cannot follow the details of this marvellous construction,—the result of unconscious and collective labor that has made of the verb a supple instrument, suited for all expressions, by the invention of moods, voices, and tenses. We may note that, as regards tenses, the distinction between the three parts of duration (which seems to us so simple) appears to have been established very slowly. Doubtless it can be asserted that it existed, actually, in the mind of primitive man, but that the imperfection of his verbal instrument failed in translating it. However this may be, it is a moot point whether the verb, at the outset, expressed past or present. It seems at first to have translated a vague conception of duration, of continuity in action; it was at first "durative," a past which still continues, a past-present. The adjective notion

[1] P. Regnaud, *Origine et philosophie du langage*, p. 317

contained in the verb, indefinitely as to time, only became precise by little and little. The distinction between the moments of duration did not occur by the same process in all languages, and in some, highly developed, otherwise like the Semitic languages, it remained very imperfect.[1]

The main point was to show how the adjective-substantive, modified by the adjunction of pronominal elements, constituted another linguistic organ, and losing its original mark little by little, became the verb with its multiple functions. The qualificatory character fundamental to it makes of it an instrument proper to express all degrees of abstraction and generalisation from the highest to the lowest, to run up the scale of lower, medium, and higher abstractions. Ex., to drink, eat, sleep, strike;—higher, to love, pray, instruct, etc.; higher still, to act, exist, etc. The supreme degree of abstraction, i. e., the moment at which the verb is most empty of all concrete sense, is found in the auxiliaries of the modern analytical languages. These, says Max Müller, occupy the same place among the verbs, as abstract nouns among the substantives. They date from a later epoch, and all had originally a more material and more expressive character. Our auxiliary verbs had to traverse a long series of vicissitudes, before they reached the desiccated, lifeless form that makes them so appropriate to the demands of our abstract prose. *Habere*, which is now employed in all Roman languages to express simply a past time, at first signified "to hold fast," "to retain."

The author continues, retracing the history of sev-

[1] On this point, consult especially Sayce, *op. cit.*, II., § 9, and P. Regnaud, *op. cit.*, pp. 296-299.

eral other auxiliary verbs. Among them all there is one that merits particular mention on account of its divagations: this is the verb *être*, verb *par excellence*, verb substantive, unique; direct or understood expression of the existence that is everywhere present. The monopoly of affirmation, and even the privilege of an immaterial origin have been attributed to it.[1] In the first place, it is not met with under any form in certain languages which supplement its absence by divers processes. In the second, it is far from being primitive; it is derived, according to the idioms, from multiple and sufficiently discordant elements: to breathe, live, grow (Max Müller); to breathe, grow, remain, stand upright (*stare*) (Whitney).

Hitherto we have examined only the stable, solid parts of speech. There remain such as are purely transitive, translating a movement of thought, expressive of *relation*. Before we study these under their linguistic form, it is indispensable to take up the standpoint of pure psychology, and to know in the first place what is the nature of a relation. This can the less be avoided inasmuch as the question has scarcely been treated of, save by logicians, or after their fashion, and many very complete treatises of psychology do not bestow on it a single word.[2]

"A relation," says Herbert Spencer, "is a state of

[1] The word *être* is irreducible, indecomposable, primitive, and wholly intellectual. I know no language in which the French word *être* is expressed by a corresponding word representing a sensible idea. Hence it is not true that all the roots of the language are in last resort signs of sensory ideas." (V. Cousin, *Histoire de la phil. au XIII siècle*, 1841, II., p. 274.)

[2] For the psychology of relation consult Herbert Spencer, *Psychology*, I., p. 65, II., pp., 360 et seq.; James, *Psychology*, I., pp., 203 et seq. The latter gives the history of the subject, which is very brief, and remarks that the idealogues form an honorable exception to the general abstention. Thus Destutt de Tracy established a distinction between feelings of *sensation* and feelings of *relation*.

consciousness which unites two other states of consciousness." Although a relation is not always a link in the rigorous sense, this definition has the great advantage of presenting it as a reality, as a state existing by itself, not a zero, a naught of consciousness. It possesses intrinsic characters: (1) It is indecomposable. There are in consciousness greater and less states; the greater (e. g., a perception) are composite, hence accessible to analysis; they occupy an appreciable and measurable time. The lesser (relation) are naturally beyond analysis; rapid as lightning, they appear to be outside time. (2) It is dependent. Remove the two terms with which it is intercalated, and the relation vanishes; but it must be noted that the terms themselves presuppose relations; for, according to Spencer's just remark, "There are neither states of consciousness without relations, nor relations without states of consciousness." In fact: to feel or think a relation, is to feel or think a change.

But this psychical state may be studied otherwise than by internal observation, and the subsequent interpretation. It lends itself to an *objective* study, because it is incarnated in certain words. When I say, red *and* green, red *or* green, there are in either case, not two, but *three* states of consciousness; the sole difference is in the intermediate state which corresponds with an inclusion or an exclusion. So, too, all our prepositions and conjunctions (*for*, *by*, *if*, *but*, *because*) envelop a mental state, however attenuated. The study of languages teaches us that the expression of relations is produced in two ways, forming, as it were, two chronological layers.

The most ancient is that of the cases or declensions: a highly complex mechanism, varying in marked

degree with the idioms, and consisting in appositions, suffixes, or modifications of the principal theme.

But these relations have only acquired their proper linguistic organ, specialised for this function, by means of prepositions and conjunctions. They are wanting in many languages; gesture being then substituted for them. The principal parts of the discourse are solitary, juxtaposed without links after the manner of the phrases used by children. Others, somewhat less poor, have only two conjunctions: *and*, *but*. In short, the terms on which devolved the expression of relations are of late formation, as it were, organs *de luxe*. In the analytical languages, prepositions and conjunctions are nouns or pronouns diverted from their primitive acceptation, which have acquired a value expressive of transition, condition, subordination, coordination, and the rest. The psychological notion common to the greater number, if not to all, is that of a movement. "All relations expressed by prepositions can be referred to repose, and to movement in space and time, i. e., to those with which the locative, accusative (movement of approximation) and ablative (movement of departure) correspond in declension."[1] It may be admitted that this consciousness of movement, of change, which is no more, fundamentally, than the sense of different directions of thought, belongs less to the category of clear notions than to that of subconscious states, of tendencies, of actions, which explains why the terms of relation are wholly wanting, or rare, and only conquered their autonomy at a late period.

With these, the progressive work of differentiation is accomplished. Discourse has now its materials and

[1] Regnaud, *op. cit.*, pp. 304 et seq.

its cement; it is capable of complex phrases wherein all is referred and subordinated to a principal state, contrary to those ruder essays which could only attain to simple phrases, denuded of connective apparatus.

We have rapidly sketched this labor of organogenesis, by which language has passed from the amorphous state to the progressive constitution of specialised terms and grammatical functions: an evolution wholly comparable with that which, in living bodies, starts from the fecundated ovule, to attain by division of labor among the higher species to a fixed adjustment of organs and functions. "Languages are natural organisms, which, without being independent of human volition, are born, grow, age, and die, according to determined laws." (Schleicher.) They are in a state of continuous renovation, of acquisition, and of loss. In civilised languages, this incessant metamorphosis is partially checked by enforced instruction, by tradition, and respect for the great literary works. In savage idioms where these coercive measures are lacking, the transformation at times occurs with such rapidity that they become unrecognisable at the end of a few generations.

Spoken language, as a psycho-physiological mechanism, is regulated in its evolution by physiological and psychological laws.

Among the former (with which we are not concerned), the principal is the law of phonetic alteration, consisting in the displacement of an articulation in a determined direction. It is dependent on the vocal organ; thus, after the Germanic invasion, the Latin which this people spoke fell again under the power of physiological influences which modified it profoundly.

Among the latter, the principal is the law of analogy, the great artisan in the extension of languages. It is a law of economy, the basis of which is generalisation, the faculty of seizing on real or supposed resemblances. The word remains invariable, but the mind gives it different applications: it is a mask covering in turn several faces. It suffices to open a dictionary to see how ingenious and perilous is this unconscious labor. Such a word has only a few lines; it has no brilliant record. Such another fills pages; first we see it in its primitive sense; then—from analogy to analogy—from accident to accident—it departs from it more and more, and ends by having quite a contrary meaning.[1] Hence it has been said that "the object of a true etymology is to discover the laws that have regulated the evolution of thought." Among primitive people, the process that entails such deviations from the primitive sense, is sometimes of striking absurdity; or at least appears to us as such by reason of the strange analogies that serve the extension of the word. Thus: certain Australian tribes gave the names of mussels (*muyum*), to books because they open and close like shell-fish; and many other no less singular facts could be cited. Much more might be said as to the rôle of analogy, but we must adhere to our subject.

In conclusion: it is to be regretted that linguistic psychology attracts so few people, and that many recent treatises on psychology, excellent on all other points, do not devote a single line to language. Yet this study, especially if comparative, from the lowest to the most subtle forms, would throw at least as

[1] It is superfluous to give examples of such a well-known fact. See Darmesteter, *The Life of Words*.

much light on the mechanism of the intelligence as other highly accredited processes. *Physiological psychology* is much in vogue, since it is rightly concluded that if the facts of biology, normal and morbid, are being studied by naturalists and physicians, they are available to psychologists also, under another aspect. So too for *languages:* comparative philology has its own aim, psychology another, proper to it. It is incredible that any one who, with sufficient linguistic equipment, should devote himself to the task, would fail to find adequate return for his labors.

# CHAPTER III.

## INTERMEDIATE FORMS OF ABSTRACTION.

HAVING thus acquainted ourselves with this new factor—speech—which as an instrument of abstraction becomes steadily more and more important, we can take up our subject from the point at which we left it. In passing from the absence to the presence of the word, from the lower to the intermediate forms of abstraction, we must again insist on our principal aim: viz., to prove that abstraction and generalisation are functions of the completely evolved mind. They exist in embryo in perception, and in the image, and at their extreme limit involve suppression of all concrete representation. This conclusion will hardly be contradicted. The difficulty is to follow the evolution step by step, stage after stage, and to note the difference by *objective* marks.

For intermediate abstraction, this operation is very simple. It implies the use of words; it has passed the level of prelinguistic abstraction and generalisation. We may go farther, and—always *with the aid of words*—establish two classes within the total category of mean abstraction:

1. The lower forms, bordering on generic images, whose objective mark is the feeble participation of the

word: it can indeed be altogether foregone, and is only in the least degree an instrument of substitution.

2. The higher forms, approximating to the class of pure concepts, and having as their objective mark the fact that words are indispensable, since these have now become an instrument of substitution, though still accompanied by some sensory representation.

The legitimacy of this division can be justified only by a detailed comparison of the two classes.

## I.

Before giving examples that determine the nature and intellectual trend of the lower forms, a theoretical question presents itself which cannot be eluded, albeit any profound discussion of it belongs to the theory of cognition rather than to psychology. It is as follows: Is the difference between generic images and the lowest concepts, one of nature or of degree? This question has sometimes been propounded in a less general and more concrete form; Is there any radical difference, any impassable gulf between animal intelligence[1] in its higher, and human intelligence in its lower aspects? Some authors give an absolute negation, others admit community of nature, and of transitional forms.

I shall first reject as inadmissible the argument that identifies abstraction with the use of words. Taine seems at times to admit this: "We think," he says, "the abstract characters of things by means of the abstract names that are our abstract ideas, and the formation of our ideas is no more than the forma-

[1] Intelligence is taken here in its restricted sense, as the synonym of abstracting, generalising, judging, reasoning.

tion of names which are substitutes."[1] Clearly if abstraction is impossible without words, this operation could only begin with speech. All that was said above (Chap. I) proves the inanity of such an assertion.

Let us, in order to discuss the question profitably, sum up the principal characteristics of generic images on the one hand, of inferior concepts on the other.

Generic images are: (1) simple and of the practical order; (2) the result of often-repeated experiences; (3) extracts from very salient resemblances; (4) a condensation into a visual, auditory, tactile, or olfactory representation. They are the fruit of *passive* assimilation.

The inferior concepts most akin to them, which we are studying in the present instance, are in character: (1) less simple; (2) less frequently repeated in experience; (3) they assume as material, similarities mingled with sufficiently numerous differences; (4) they are fixed by a word. They are the fruit of *active* assimilation.

It may be said that the two classes, when thus opposed to each other, present but minimal differences, save for the addition of words. For the moment, indeed, the word is only an instrument handled by a bad workman, who ignores its efficacy and highest significance, as will be proved below. But were it otherwise, and were the delimitation between the two classes in no way fluctuating, the thesis of a progressive evolution must needs be given up, unless it be admitted to begin only with the appearance of speech.[2]

[1] *De l'intelligence*, Vol. I., Bk. IV., Chap. I., p. 254, first edition.

[2] *De l'intelligence*, I., Bk. iv., chap. 1, p. 254, first ed.

Romanes describes the passage from the generic image to the concept as follows:

"Water-fowl adopt a somewhat different mode of alighting upon land, or even upon ice, from that which they adopt when alighting upon water; and those kinds which dive from a height (such as terns and gannets) never do so upon land or ice. These facts prove that these animals have one recept answering to a solid substance, and another answering to a fluid. Similarly a man will not dive from a height over hard ground, or over ice, nor will he jump into water in the same way as he jumps upon land. In other words, like the water-fowl, he has two distinct recepts, one of which answers to solid ground, and the other to an unresisting fluid. But unlike the water-fowl, he is able to bestow upon each of these recepts a name, and thus to raise them both to the level of concepts. So far as the practical purposes of locomotion are concerned, it is, of course, immaterial whether or not he thus raises his recepts into concepts; but, as we have seen, for many other purposes it is of the highest importance that he is able to do this. Now, in order to do it, he must be able to set his recept before his own mind as an object of his own thought: before he can bestow upon these generic ideas the names of "solid" and "fluid," he must have cognised them as ideas. Prior to this act of cognition, these ideas differed in no respect from the recepts of a water-fowl; neither for the requirements of his locomotion is it needful that they should: therefore, in so far as these requirements are concerned, the man makes no call upon his higher faculties of ideation. But, in virtue of this act of cognition whereby he assigns a name to an idea known as such, he has created for himself—

and for purposes other than locomotion—a priceless possession; he has formed a concept."[1]

In point of fact, the transition is not so simple. Romanes omits the intermediate stages: for with fluid and liquid we penetrate into a more elevated order of concepts than those immediately bordering on the generic image. What he well brings out is that the bare introduction of words does not explain everything. It must not be forgotten that if the higher development of the intelligence depends upon the higher development of abstraction, which itself depends upon the development of speech, this last is conditioned, not simply by the faculty of articulation, which exists among many animals, but by anterior cerebral conditions that have to be sought out.

For these, we must return to the distinction loosely established above, between passive and active assimilation. We know that the fundamental mechanism of cognition may be reduced to two antagonistic processes, association and dissociation, assimilation and dissimilation; to combine, to separate; in brief, analysis and synthesis.[2] In the formation of the generic image, as we have seen, assimilation plays the principal part; the mind works only upon similarities. In proportion as we recede from this point, we have the contrary; the mind works more and more upon differences; the primitive and essential operation is a dissociation; the fusion of similarities only appears later. The further back we go, the more analysis preponderates, because we are pursuing resemblances

[1] *Mental Evolution in Man*, pp. 74 and 75.

[2] As Paulhan remarks, "L'abstraction et les idées abstraites" (*Revue Philosophique*, Jan., 1889, p. 26 et seq.), these two processes are initially linked one with the other, so that we find analytical syntheses, and synthetical analyses.

more and more hidden by differences. Coarser minds do not rise above palpable similarities. The peasant who hears a dialect or patois closely akin to his own understands nothing of it; it is another language to him; whereas even a mediocre linguist immediately perceives the identity of words that differ only in accent.

We may represent the differences between generic images, and these general notions that most nearly approximate to them, by the following symbol:

| I. | II. |
|---|---|
| *A B C d e* | *A b c d e* |
| *A B C e f* | *x y z A f* |
| *A B C g h*, etc. | *g A h k m*, etc. |

where each line corresponds to an object, and each letter to one of the principal characters of the object. Table I is that of the generic image. A part, *A B C*, is constantly repeated in each experience; moreover, it is in relief, as indicated by the capitals; the elimination of differences is almost passive,—self-caused; they are forgotten.

Table II is that of a fairly simple general notion. Here *A* has to be disengaged from all the objects in which it is included. It still has a salient character, indicated by capitals, and recurring in each object; but as it is merged in the differences, as it represents but a poor fraction of the total event, it is not disengaged spontaneously; it exacts a preliminary labor of dissociation and elimination.

Thus understood, the difference between the two processes consists only in the faculty of greater or less dissociation, and we are in no way authorised in assuming a difference of nature.

But the question may be propounded in a different

manner,—more precise and more embarrassing. I formulate it thus: the generic image is never, the concept is always a judgment. We know that for logicians (formerly at any rate) the concept is the simple and primitive element; next comes the judgment, uniting two or several concepts; then ratiocination, combining two or several judgments. For the psychologist, on the contrary, affirmation is the fundamental act; the concept is the *result* of judgments (explicit or implicit), of similarities with exclusion of differences. If in addition to this we recall what was said above: that speech commences with phrases only, that in its simplest form it is the word-phrase; then the debated question may be thus transformed: Is there, between the generic image and judgment in its lower forms, a break in continuity, or a passage by slow transformation?

For the partisans of the first theory, the appearance of judgment is a "passage of the Rubicon" (Max Müller). It is as impossible to deny this as to affirm it positively and indisputably. Romanes, who makes a stand against the "passage of the Rubicon," admits the following stages in the development of signs, taken as indicative of the development of intelligence itself.

1. The indicative sign; gesture or pronominal root; a dog barking for a door to be opened, etc.

2. The denotative sign which is affixed to particular objects, qualities, or actions; for example, the parrot which on seeing a person utters the name of the person, or some word which it has associated with him, and which for the animal has become the distinctive mark of the person.

3. The connotative or attributive sign, which,

rightly or wrongly, is attributed to an entire class of objects having a common quality; for instance, the child which applies the word *star* to everything that shines.

4. The denominative sign; or the intentional employment of the sign as such, with a full appreciation of its value; for example, the word *star* in its meaning to the astronomer.

5. The predicative sign, or a proposition formed by the apposition of two denominative signs.[1]

This hierarchical order, while in some measure open to criticism, indicates at least schematically the progressive passage from the concrete to the higher abstractions, and may therefore be accepted.

It is clear that the two first stages scarcely pass beyond the concrete.

To the third, Romanes attaches capital importance: judgment begins with it. It may, however, be asked if affirmation really exists at this stage. For my own part I am inclined to admit it as included in the generic image in its highest degree (for here too there are degrees), under the form *not of a proposition, but of an action.* The hunting dog assuredly possesses generic images of man and of different kinds of game, under the visual and more especially the olfactory form. When it starts off on the scent of its master, of a hare, or of a partridge, this is surely a judgment of a certain kind, an affirmation, the least doubtful of all, seeing that it is an act. The absence of verbal expression and of logical information in no way alters the fundamental nature of the mental state. We have already (Chap. I.) spoken of *practical* judgments and ratiocinations; it is needless to reiterate.

[1] *Op. cit.*, VIII., 158-165.

The transition from the third to the fourth stage is even more important. It is here that the true concept appears; this point attained, an almost unlimited progress is possible. Now the true cause of the true concept is reflexion. This formula appears to us the simplest, the briefest, the most clear, and the most exact. There is the possibility of concepts where there is the possibility in the mind of detaching a single character (or several), extracted from among many others, of setting it up as an independent entity, of raising it into a *known* object, i. e., determined in its relations with ourselves, and with other things. Example: to form the general idea of a vertebrate. But this fundamental act—reflexion—is not without antecedents, it does not spring forth as a new apparition. It is the highest degree of attention, i. e., of a mental attitude that we encounter very low down in the animal scale.

Discontinuity of evolution, in the passage from lower to higher, is thus far from being established. Doubtless this, like all other questions of genesis, leaves much to hypothesis, and can only be decided on probabilities: yet these do not appear to favor a rupture in continuity, and opposition of nature.

In sum—to confine ourselves to what is least contestable: given the cerebral and psychological conditions for speech (not for articulate language alone), and application of words to qualities and attributes raised little by little into independent entities,—and the decisive step has been taken. Such is intellectual progress, and we may remark in passing that the process which creates the true concept, leads fatally by the same issue to faith in idols, in the entities realised.

Without for the moment pausing at this last point, let us under a more positive form, and strictly on the lines of experimental psychology, examine the nature of the lower forms of intermediate abstraction, determining it by examples. At the same time we shall fix the intellectual level that corresponds to the moment of transition between generic images (animal form), and the higher abstracts which have still to be studied in detail. The best method is to take as a type such human races as have remained in the savage or half-civilised state: these are more instructive than childhood, because they represent fixed and permanent conditions. We can draw on two principal sources: their languages, and their systems of numeration. Their religious beliefs might also be studied, with the same results, but this would take too long, and would moreover be less definite.[1]

1. *The languages*, considered under their most general characteristics, reveal a notable impotence for transcending the simplest resemblances, an incurable incapacity for extended generalisations; they hardly rise above the concrete. Words play a very indistinct part; they are the most incomplete substitute—hardly more than a mark, a sign, like gestures—differing from the latter only in the future they carry within them. The study of the ascending progress of generalisation is in effect the study of the successive phases of the emancipation of speech up to the time when it

[1] We have touched on this subject incidentally in *La psychologie des sentiments* (Part II, IX, § 2, pp. 305 et seq.). Many tribes do not get beyond polydemonism, peopling the universe with innumerable genii; this is the reign of the concrete. A certain progress is marked by subordinating the genius of each tree to the god of the forest, the different genii of a river to the god of the river, etc. At a degree higher, the intellect constitutes a single god for water, one for fire, one for the earth, etc. Thus there come to be genii of individual, specific, and generic origin.

becomes preponderant and dominating. At the actual stage, which might be termed *concrete-abstract*, it is not yet emancipated; it is a minor, under tutelage.

Let us take in turn substantives, adjectives, and verbs.

The indigenes of Hawaii, says Max Müller (*Lectures on the Science of Language*, Second Series, II., p. 19), have but one word, "aloba," to express love, friendship, esteem, gratitude, benevolence, etc.; on the other hand, words to express variations in the direction of the force of the wind are very numerous, proving once more how at its origin abstraction or dissociation is governed by practical causes. In savage languages there are terms to express not merely each species of dog, but their age, the color of their hair, good or bad qualities, etc. So, too, for the horse; there are special words to designate its varieties, and all its movements; to indicate if it is mounted, not mounted, frightened, running away, and the like. The North American Indians have special words for the black oak, the white oak, and the red oak, but none for the oak in general,—still less for tree in general. The indigenes of Brazil can point out the different parts of the body, but not the body as a whole (Lubbock). Among several tribes of Oceania, a special word is employed for the tail of a dog, another for the sheep's tail, and so on, but they have no designation for tail in general. Again, there is no common term for the cow, but there are distinct words for red, white, or brown cows (Sayce).

There are, however, cases of very clear progress in generalisation; the significance of a word extends itself; from specific it becomes generic. This metamorphosis exists *in vivo* among the Finns and Lap-

landers. The former have a name for the smallest stream, and none for river; originally again there was a term for each finger, none for finger in general; but latterly the term used for thumb alone has come to designate the fingers collectively. Among the second race, certain tribes who had a special denomination for each kind of bay, have now adopted one that serves for all kinds (Max Müller).

The same holds good of the poverty of the adjective, the abstract term proper. The case of the Tasmanians has often been quoted, how they could only express qualities by concrete representations: hard = like a stone; long = legs; round = like a ball, like the moon, etc. (Lubbock). A less familiar case, termed by linguists "concretism," is met with even in certain more developed idioms, like a survival of the time when the mind was unable to detach itself from the concrete, or to forego a complete and detailed qualification. Instead of saying ten merchants, five hens, the idiom is merchants ten men, hens five birds, and so on for similar cases.

The verb is able to express all degrees of abstraction and of generalisation as well as the adjective and substantive. At this period, it exactly repeats the type (as described above) of the substantive with its burdensome multiplicity,—for want of a generalisation simple enough, according to our judgment. The North American Indians have special words for saying: to wash one's face, another person's face, the linen, utensils, etc.: in all, thirty words, but none for washing in general. So, too, for eating bread, fruits, meat, etc., striking with the hand, foot, axe, etc., for cutting wood, meat, or any other objects: for all these there are special terms, but none for saying simply,

to eat, to knock, to cut (Sayce, Hovelacque.) On the other hand, we note a case of transition, analogous to that of the Lapps and Finlanders. Certain tribes in Brazil have a few verbs of general, simple significance: eat, drink, dance, see, etc., even love, thank, etc. (Lubbock).

We need not multiply examples; these will suffice to throw into relief the extreme impotence in generalising, so soon as the mind loses its hold on the concrete. We might also recall the difficulty so often experienced by missionaries. They find it almost impossible, even by creating new words, or by changing the meaning of others, to translate the sacred books into these idioms, from their paucity of concrete terms.

2. *The numeration,* taking its development as a whole, appears to sub-divide into three principal periods: concrete numeration, as studied above, in animals and children; concrete-abstract numeration, with which we are now occupied; purely abstract numeration, which we shall examine later, as translated into organised arithmetic.

We have seen that speech at its origin was so humble as to need gesture to complete and to elucidate it. During its concrete-abstract period, numeration is in an analogous position. At first its extension is very limited: it progresses slowly and painfully from unity. Further, it can operate only when sustained by the concrete; it must have a material accompaniment. Counting is accomplished by the enunciation of words, with the aid of enumerated objects, as perceived at the same time, or with that of the fingers: which, let it be remarked, is the first essay in

substitution. There is simultaneously concrete or digital, and verbal numeration.[1]

We know that many Australian and South American tribes can count verbally to two only; some say two-one = three; two-two = four; others by the same process arrive at six (two-three = five, three-three = six): everything else is "much." For the most part they count without words, with the aid of fingers or of articulation; even when they employ words, the two numerations—digital and verbal—are performed simultaneously.[2]

This manner of counting is in first degree concrete; the concrete-abstract form is only there in embryo. A great advance, made early enough in many tribes, consisted in counting by five, taking the hand (five fingers) as a new unit, superior to the simple unit.

[1] Tylor, *Primitive Culture*, I., gives abundant data on this question. Chap. VII. is entirely devoted to it.

[2] In the account of his travels among the Damaras (in his *Tropical South Africa*, p. 133) Galton says: "In practice, whatever they may possess in their language, they certainly use no numeral greater than three. When they wish to express four, they take to their fingers, which are to them as formidable instruments of calculation as a sliding-rule is to our English schoolboy. They puzzle very much after five, because no spare hand remains to grasp and secure the fingers that are required for 'units,'—yet they seldom lose oxen: the way in which they discover the loss of one, is not by the number of the herd being diminished, but by the absence of a face they know." [This tallies with what we said above, Chap. I., as to so-called numeration in animals and children.] "When bartering is going on, each sheep must be paid for separately. Thus suppose two sticks of tobacco to be the rate of exchange for one sheep, it would sorely puzzle a Damara to take two sheep and give him four sticks. I have done so and seen a man first put two of the sticks apart and take a sight over them at one of the sheep he was about to sell. Having satisfied himself that one was honestly paid for, and finding to his surprise that exactly two sticks remained in hand to settle the account for the other sheep, he would be afflicted with doubts; the transaction seemed to come out too pat to be correct, and he would refer back to the first couple of sticks, and then his mind got hazy and confused, and wandered from one sheep to the other, and he broke off the transaction until two sticks were put into his hand and one sheep driven away, and then the other two sticks given him and the second sheep driven away." Galton relates many other similar facts which he had himself witnessed.

Then: one hand = 5; two hands or half a man = 10; two hands, one foot = 15; two hands, two feet, or a man = 20. Such is the evident origin of the quinary, decimal, and vigesimal numerations. Sometimes fingers, as instruments of numeration, have been replaced by objects of a typical number. Ex.: 1 = moon or sun; 2 = the eyes or legs, etc.

However varied these processes (of which only a few have been mentioned) in different races and periods, they are fundamentally identical to the psychologist. They may be reduced to this; numeration is performed more particularly with the aids of sensible perceptions; words are but an insignificant accompaniment, a superfluity—existing only as a proliferation—of so little utility that they are for the most part neglected.

Though it is less often spoken of, we may remark that the measure of continuous quantity passed through the same concrete-abstract phase; and here it appeared at a somewhat early stage, owing to practical and social wants. Hence we find at the outset, the foot, the finger, the thumb (inch = Fr. *pouce*), the palestra (four fingers' length), span, cubit (arm's reach = *coudée*), fathom, etc., the stadium (distance a good runner could cover without stopping).[1] The concrete character of all these measures is obvious. Again, there are survivals in certain current locutions, such as a day's journey. More than this; they have a *human* character, their standard and starting-point being, at least at the outset, certain parts of the body, or a determined sum of muscular movements. Little by little they lost their original significance, progressing through centuries towards our metrical system

[1] And the barley-corn of English measure.—*Tr.*

the type of a scientific, deliberate, rationally abstract system, as far as possible liberated from anthropomorphism.

The reader will probably obtain a more definite idea of the nature of these lower forms by recapitulating the examples cited, than from any long dissertation. Is their intellectual level very superior to that of the generic image? This question is doubtful. At times the only distinction between them is the presence of the word: at the present stage it makes but a poor figure,—yet with all its modesty, it augurs a new world wherein it is to be of prime importance.

## II.

We now pass to a study of transition. In ascending from the lower to the *higher* forms of abstraction, we traverse the intermediate region between the states directly superposed upon generic images, and the higher concepts. In fact, we shall to some extent have to penetrate into this extreme region, before the close of the chapter.

At the risk of repetition, we must first indicate the characteristics by which the general notions we are at present concerned with are distinguished from the abstractions above and below them. To recapitulate briefly: In the concrete-abstract phase (which we are leaving) the general notion—so-called—is constituted by concrete elements, *plus* words, whose substitutory office is weak or null.

In the abstract phase (upon which we are entering) the concept is constituted by an evoked or evocable image, which may exhibit every degree from clear

representation to the pure schema, *plus* the word that now becomes the principal element.

In the phase of higher abstractions (to be studied later), no sensory representation arises, or should any such appear, reflexion would find in it only a dubious support, often an obstacle: the word meantime has acquired absolute supremacy in consciousness.

Taken as a whole, psychological development exhibits a complex phenomenon, a binary compound, in which one element is always increasing, the other as steadily decreasing. Words pass from nonentity to autocracy; the concrete from supremacy to nonentity.

We must now return to the higher forms of intermediate abstraction, since we may not content ourselves with any purely theoretical determination. Characteristic examples must be selected; and here we find a certain embarrassment. Does our choice fall on numeration? Yet on leaving the concrete-abstract period, this at once finds its formative law, and introduces us to pure abstraction. Are we to select language? This procedure might seem to be appropriate, seeing that the general ideas with which we are occupied constitute the substrata of our highly civilised modern languages, when, on the other hand, the more developed concepts (of mathematics, metaphysics, etc.) are only found rarely and incidentally. One might even plunder the dictionary, extracting all general terms, with elimination of those that are purely scientific, and classification of the former according to their increasing degree of generality. But this method, besides being very laborious and incapable of reduction to a clear statement for the reader, would suffer the cardinal defect of being arbitrary. How, indeed, could any common measure be estab-

lished for all these general terms, issuing from the most diverse sources of human activity?[1]

But the best method would seem to be that of taking as our basis the classifications of the naturalists, following their development historically. Here we have the advantage of positive documents, since these refer to concrete beings, and are formed according to characters observed empirically. They create, namely, an ascending progress from the individual to the more general notions, by a methodical process of filiation; they operate upon living beings, or objects of the same nature, having consequently a common standard. The history, even in brief, of these classifications is instructive: it shows the progressive passage of concrete-abstract ideas to more and more abstract concepts, from a statement of gross resemblances to the quest after subtle similarities, from the period of assimilation to that in which dissociation predominates.

Among these different classifications, we may select those of the zoologists, since they appear to be the most numerous, most complete, and best elab-

[1] Wundt (*Logik*, I., pp. 113 et seq.) gives what he regards as a complete classification of concepts, but it does not correspond with our design. It may be summarised as follows. Four classes: I. Identical or equivalent concepts; Aristotle = Alexander's tutor. II. Subordinate or superordinate concepts; mammals and vertebrates, etc. III. Co-ordinated concepts, comprising five species: i. Disjunctive concepts; sound and noise, French and German, etc. They are subordinate to a larger concept. ii. Correlative concepts, with reciprocal relations; men and women, mountain and valley. iii. Contrary concepts; high and low, good and bad. iv. Contingent concepts; such, i. e., as touch, with very minute, perceptible differences; this highly important category comprises numbers. v. Interferent concepts, which coincide or partially cross; negro and slave, rectangle and parallelogram. IV. Concepts which are interdependent; etc., space and movement, crime and punishment, demand and supply, labor and wages. This table may suit the logician but not the psychologist, because it presents the concepts under what may be termed the static order, i. e., ready formed: we, on the other hand, are considering them as dynamic, i. e., in their becoming and order of genesis.

orated. For the rest, the succeeding observations apply equally, *mutatis mutandis*, to the classifications of the botanists. We need scarcely add that our study is strictly psychological, that its object is not the absolute value of classifications, but the determination of the processes followed by the human mind, in proportion as the zoological taxonomy has constituted itself.

At the outset we find a pre-scientific period as to which we know little; for these essays in classification differ, according to times and races. The Bible, Hindu literature, the primitive poets and historians of Greece, do however provide sufficient indications of the manner in which man originally classified other living beings. The repartition was usually made in three great categories, according as the animals lived in the water, or upon the earth, or flew in the air. The subdivisions are remarkable. Thus, among terrestrial animals, there are some that walk, and some that climb: in this last group there is a mixture of articulate creatures, of molluscs, reptiles and amphibians. Among aerial animals, we find birds, and many flying insects. These primitive classifications are based upon perception far more than on abstraction, or at any rate rest upon superficial resemblances. The habitual environment, air, water, earth, determines the cardinal classes. Some easily apprehended characteristic makes the subdivisions: e. g., flight (birds, insects), locomotion (walking, climbing). The method employed is hardly superior to that by which generic images are formed; and in the order of classification, this point corresponds with the concrete-abstract period of primitive languages, numerations,

and religions, i. e., to a gross generalisation fixed by a word.

The scientific period begins with Aristotle. It has been affirmed that he owes numerous points to predecessors whom he fails to mention: this is a historical matter of no interest in the present connexion. With him, or under his name, we have the commencement of comparative anatomy which involves a preliminary labor of analysis, unknown in the pre-scientific period, and marking the transition from apparent and superficial to profound and essential resemblances. His classification is of course imperfect, often inconsistent; it bears the impress of an epoch of transition.

His terminology is poor, unstable, floating. He distinguishes two sorts of groups only: the genus (γένος) and the species (εἶδος). "But the term γένος has the least constant significance: it serves as the indistinct designation of any group of species, however great its extension, as well what we now term classes, as other lower groups."[1] Sometimes however Aristotle speaks of large genera (γένη μέγαλα) and of very large genera (γένη μέγιστα), without any precise denotation. It has been said that penury of words was an obstacle to him: yet this is hardly a plausible reason, seeing that he found means to create the word ἔντομα to designate insects. The true obstacle was the insufficient determination of character.

Again, independently of nomenclature, "while Aristotle knew a fairly large number of animals, the notion of grouping them in definite order, which should express their greater or less degree of similarity, does not appear to have presented itself to his

[1] For details, with quotations in point, consult Agassiz: *De l'espèce*, Chap. III., and E. Perrier, *La Philosophie zoologique avant Darwin*, Chap. II.

mind. Hence he did not attempt what we call classification. He compares different animals together, by every possible means, and endeavors to reduce the result of his comparisons to general propositions." In this way he arrives at relations which are sometimes important, sometimes without importance. For example: among animals, some have blood, some lymph, which takes its place: this division, notwithstanding the error on which it is based, corresponds broadly speaking with the distinction between vertebrates and invertebrates. Animals "which have blood" are subdivided into viviparous and oviparous. Further, animals that fly are ranged in three categories, according as their wings are feathered (birds), or formed by a fold of skin (bats), or dry, thin, and membranous (insects). Then there is a division of animals into aquatic and terrestrial, social and solitary, migratory and sedentary, diurnal and nocturnal, domestic and wild, etc.

In sum, there is co-existence of two processes: one scientific, implying a preliminary analysis; the other of common observation, which does not sensibly differ from concrete-abstract classifications; and the idea of a hierarchy formed by abstraction of abstracts, by a systematic arrangement of the animal kingdom, has not yet made its appearance. Yet Aristotle's work, just by reason of its composite nature, is interesting to the psychologist who studies the evolution of the faculty of abstracting and generalising.

We may pass over two thousand years, during which no progress was made, till we come to Linnæus. "He was the first man who distinctly conceived the idea of expressing, under a definite formula, what he believed to be the system of nature." His nomencla-

ture is fixed. Under the names of classes (*genus summum*), orders (*genus intermedium*), genera (*genus proximum*), species, varieties, he proposes subdivisions of decreasing value, embracing a greater or less number of animals which all present in common more or less general attributes. He pursues the research after fundamental characteristics, and *essential* similarities, incessantly correcting his first results. Thus it is only at the eleventh edition of his *Systema naturæ* that the class of "Quadrupeds" is converted into Mammals: the Cetacea are included in this class, and no longer placed among the fish, as also bats, which were formerly classified with birds, etc.[1] Whatever their objective value, we have here a true system of rational concepts.

We may instance Cuvier for the clearness with which he separates the predominant and subordinate characteristics: "If," he says, "we consider the animal kingdom on the principles just laid down, regarding only the organisation and nature of the animals, instead of their size and utility, according to our knowledge of them, or the sum of accessory circumstances, we find that there are four principal forms, four general plans, if we may so express ourselves, on which all animals seem to have been modelled," etc. These four branches (a new word created by him), which he held to be irreducible, were the Vertebrata, Articulata, Mollusca, and Radiata.

Finally, since the progress of consecutive abstraction and generalisation consists in incessantly seeking

[1] Agassiz, *op. cit.*, gives a summary of the successive improvements. They are of interest not merely to the zoölogist, but also from our own point of view, as showing the increasing preponderance of analysis, and search for fundamental characteristics, to the exclusion of the external resemblances which served as basis for the more primitive classifications.

out extracts of extracts, and simplifications of simplifications, the natural movement of the mind tends fatally towards pure unity as its supreme end. This last phase belongs to the nineteenth century, and still more to the contemporary epoch. It comes from various sources, and has assumed different forms :

1. Speculative in the school of Schelling. To Oken, the highest representative of this view, man is the prototype and measure of animal organisation ; all other animals are constructed after his pattern. "Their body is in some sort the analysed body of a man ; the human organs live, whether in isolation, or in different combinations, in the state of independent animals. Each such combination constitutes a class."

2. Embryological, according to the labors of Von Baer. While Cuvier, in classification, brought anatomy and morphology to the front, a new system now appears, founded upon development only ; the science of embryology. To be accurate, Baer's conception was not unitary, since it admitted four types : peripheral (radiate), massive (molluscan), longitudinal (articulated), bi-symmetrical (vertebrate). But little by little, the oft-substantiated principle asserted itself and found firm footing among his successors : the animal with the highest organisation passes, during its individual development, through phases which, in less highly evolved beings, are permanent states ; or, more briefly, among the higher animals, ontogenesis is a repetition of phylogenesis.

3. Transformist. The boldest partisans of this view, e. g., Haeckel, adopt a rigorously unitary conception : all the innumerable examples of the animal kingdom have issued from one common stock.

In all there is a fundamental trend of the mind to-

wards the idea of original unity. It is unimportant for the moment to examine whether this concept of ideal unity (we might also recall the vegetable ideal of Goethe, and the vertebrate ideal of Richard Owen) is a delusion, or a true apprehension : we shall return to this later, in discussing the *objective* value of the notions of genus and species (Chap. V. § vi). At this point, the *subjective* psychological process alone is relevant to our purpose.

This review has no pretensions at being even an abridged history of zoölogical classifications. It merely aims at showing by facts, (1) how a hierarchy of concepts is constituted, and in the travail of centuries passes from the period of generic images to the ideal of embryological unity, common to all beings ; (2) how the work of dissociation and analysis has always gone on, and multiplied, in quest of similarities more and more difficult to discover—often indeed fragile or dubious—to stop at unity only, the supreme abstraction.

We are now at the threshold of the last period of abstraction, that of complete symbolism, and it is not without interest to note that what passes in the theoretical order has its equivalent in another form of human activity—the practical order—where the mechanism of exchange is again developed by the aid of an ever-increasing substitution. Thus, at the lowest stage, all commercial transactions are reduced to truck, to exchange by barter. The concrete for the concrete is the method of primitive peoples. An immense step is taken when this rudimentary process is succeeded by the employment of precious metals. A substitutory value is taken as the common measure of other values. At the outset, silver and gold, in the form of powder or of small bullion, were weighed out

by the contractors for each particular transaction. Next, this inconvenient procedure was replaced by coined money, issued under the control of an officer, or of the social aggregate, thus conferring a general value on the instrument of exchange. Lastly, at a much later period, bills of exchange, bank-notes, and numerous forms of letters of credit, were substituted for gold and silver; so that a sheet of paper worth less than a centime may become the symbol of millions and tens of millions.

This resemblance of the two cases is by no means fortuitous. It is based upon identity of psychological process, namely a substitution of ascending degrees, an ever increasing simplification, whether in the order of speculative research, or in the department of commercial transaction: and just as paper tokens, unless financially convertible into objects of consumption, for use or luxury, are nonentities that can accumulate in the bank without the gain of anything more than a simulacrum—so, if the highest symbols of abstraction cannot be reduced to the data of experience, we may, as too often occurs, accumulate, manipulate, build up concepts, and still be in a state of permanent intellectual bankruptcy.

# CHAPTER IV.

## THE HIGHER FORMS OF ABSTRACTION. THEIR NATURE.

BEFORE we embark on the study of the principal concepts, it is incumbent upon us (in order to determine for each of these, separately, the conditions of their genesis and development—as was shown for abstraction in general) to throw as much light as possible upon the very vexed question of the psychological nature of the concepts of pure symbolism, where the word appears as the sole element that exists in consciousness. Is it true that we can think effectually and usefully with words and nothing but words, as has been sustained to satiety? Is not this assertion founded upon the misapprehension of a factor which, although it does not enter into consciousness, is none the less in active existence? The investigation of this point is the prime object of the following chapter.

It is unnecessary to enter in detail into the researches of the last thirty years, as to the seat and the nature of images. Yet since these have been the point of departure of the following inquiry, the results may be briefly summarised.

It is generally admitted that the image occupies the same seat as the percept of which it is a weak and

incomplete residuum, i. e., in order to produce itself in consciousness it demands the putting into activity of certain definite portions of the cerebral centres. The energy of the representative faculty does not merely vary from individual to individual in a general manner: there are particular forms of imagination, constituted by the very marked predominance of a certain group of representations, visual, auditory, muscular, olfactory, gustatory.

Normal observation, and still more pathological documents, have thus determined certain types. We may also (though this is mere hypothesis and difficult to verify) admit a "mixed" or "indifferent" type, in which the different species of sensations are represented by corresponding images of equal clearness and vigor, without marked predominance of any one group, whilst still maintaining their relative importance: e. g., it is clear that in man the visual and olfactory images cannot be equivalent in absolute importance. Excluding this indifferent type, we have three principal "pure" types: visual, auditory, muscular or motor, signifying a tendency to represent things in terms borrowed from vision, from sound, or from movement. If we push the investigation further, we find that these types again imply variations or subtypes. Thus there may be a lively faculty for representation of complex visual forms (faces, landscapes, monuments) along with a weak sense for graphic signs (printed or written words) and so on.

The numerous works devoted to this subject, and too well known to be insisted on here, lead us to this conclusion: that there is no general faculty of imagination. This is a vague term which designates very different individual variations; these last alone have

any psychological reality, and are alone important in cognising the mechanism of the intellect.

May it not be the same for the faculty of conception? May not the word "general idea" or "concept" be in its kind the equivalent of the word image, namely a vague formula,—its psychological reality lying in types or variations as yet undetermined? I am exposing for ideas, the problem that has already been set forth for images, while recognising its much greater obscurity. The psycho-physiological conditions of the existence of concepts are practically unknown: this is a *terra incognita* wherein the new psychology has hardly adventured itself, and where it would indeed have been chimerical to tread before the preliminary study of the image.

I.

The question I have set myself to elucidate is very modest, very limited and circumscribed, representing only part of the problem indicated above. It may, however, teach us something of the ultimate nature of concepts. It is as follows:

When we think, hear, or read a general term, what arises as sign in consciousness, *directly and without reflexion?*

I have purposely italicised these words in order to emphasise my principal aim, which was to discover the *instantaneous* operations (conscious or unconscious) that occur in such a case, in persons whose habits of mind are widely different. I endeavored as much as possible to eliminate reflexion and to seize the mental state. With time and effort, minds that are least apt in abstraction will arrive at a more or less successful translation of general terms, or at the substitution for

them of some mangled and halting definition. I set myself as far as possible to suppress this secondary phase of the mental process, and to arrest it at the first, in order to determine what the word evokes immediately[1] and in what degree this differs with the individual.

In order to make the answers more exactly comparable, I interrogated only the adults of both sexes, excluding all children. It was indispensable to my investigation that it should comprise people of very different degrees of culture, habits of mind, and profession. The principal classes were mathematicians, physicists, doctors, scientists, philosophers, painters, musicians, architects, men of the world, women, novelists, poets, artisans. The last class made such confused replies that I must regard their documents as worthless. Too much is left for individual interpretation. The total number of persons interrogated amounted to one hundred and three.

The method was invariably the same. We said to the subject: "I am going to pronounce certain words; will you tell me directly, without reflexion, whether this word calls up anything or nothing in your mind? If anything, what is suggested to you?" The reply was noted down at once; if delayed beyond five to seven seconds, it was held to be null, or doubtful. In the case of naïve subjects, I employed certain preliminaries: before pronouncing abstract words, concrete

[1] Under the heading "Observations on General Terms" the *American Journal of Psychology*, III. i, p. 144 (Jan., 1890) gives the results of an investigation conducted upon 113 school children aged 13 to 18. The words *being*, *the infinite*, *literature*, *abstraction*, *number*, *play*, *coldness*, *horror*, etc., were written down, and a few moments were given the pupils to transcribe their impressions in each case.

The summarised answers are not devoid of interest, but the object of the inquiry is evidently very different from our own.

terms (designating a monument, or person) such as would evoke a simple image, were heard; then the impulse being given, I proceeded to the enumeration of general terms.

The words which served as material for the inquiry were fourteen in number, proceeding from the concrete to the highest abstractions. They were enunciated in an indifferent order and were as follows: *dog, animal, color, form, justice, goodness, virtue, law,*[1] *number, force, time, relation, cause, infinity.*

The inquiry was invariably oral, never in writing, the greatest care being taken to prevent the person from knowing the end in view, unless afterwards: which led in certain cases to interesting explanations. The very nature of my method prevented me from extending it as widely as I could have wished. I could not, as was done in England, distribute printed questions among the public, because it was necessary to note the spontaneous answer immediately before it was corrected by later reflection. Moreover, I needed unsophisticated subjects, ignorant of my purpose, and therefore eliminated all whom I suspected of being even indirectly acquainted with it.

The majority were interrogated on the fourteen terms cited above, others on a few only; so that the total number of responses was over nine hundred. It would be beside the mark to publish them here. They are nothing more than data which have to be interpreted. Three principal or pure types appear to stand out from them, besides the failures or mixed cases. These may be termed the *concrete* type, the

[1] The word "law" was purposely chosen for its ambiguity; physical laws, moral or social laws. The immense majority of answers were in the juristic sense. Ex., Code, Law of the Twelve Tables, a judge, woman with scales, etc.

*visual typographic* type, and the *auditory* type. Each of these corresponds with a particular mode of representing the general idea. We will examine them separately.

1. Concrete Type. Here the abstract word nearly always evokes an image, vague or precise; usually visual, sometimes muscular. It is not a simple sign, it does not represent the total substitution, it is not dry, and finally reduced. It is immediately and spontaneously transformed into a concrete. In fact, the persons of this type think only in images. Words are for them no more than a kind of vehicle, a social instrument of mutual comprehension. When a sequence of general or abstract terms passes through their minds, what really passes is a succession of concretes, save for the very abstract words which "evoke nothing." This is an answer I have often received, and which, in virtue of its importance, will be considered apart, at the end of this chapter.

The concrete type appears to be the most widely distributed; it obtains almost to exclusion among women, artists, and all who have not the habit of scientific abstraction. I have selected a few examples from among the many observations belonging to this type.

A painter.—*Cause:* nothing. *Relation:* relations of terms; recital, written report. *Law:* judges in red robes. *Number:* vague. *Color:* contrast between green of plant, and red of drapery. *Form:* a round block, a woman's shoulder. *Sound:* a murmur. *Dog:* ears of a dog running. *Animal:* vague collection, as in certain Dutch pictures. *Force:* hits out with his fists. *Goodness:* his young mother, seen vaguely. *Time:* Saturn with his scythe. *Infinity:* a black hole.

A woman.—*Cause:* I had been the cause of her son's success. *Law:* the government is bad. *Color:* sees an impressionist picture by her son. *Form:* names a beautiful person. *Goodness and Virtue:* names two people who each have this quality. *Force:* sees men fighting. *Relation:* social relations between husband and wife. *Justice:* sees an audience-hall and judges. *Dog:* sees a dog that bit one of her parents. *Infinity:* nothing. *Time:* a metronome.

These two interrogatories are complete. I might proceed by another method: that of taking each general term (law, cause, number, etc.) and quoting all the answers received, among which many would be identical. Such an enumeration would be long and superfluous: we cannot, however, neglect a few of the particulars. For the word *cause*, several persons (women, artists, people in society) replied "*cause célèbre*," "*procès célèbre*," for the most part mentioning one only, and that some recent trial. At first this reply annoyed me, and appeared to be useless for my inquiry. Later, on the other hand, I felt it to be instructive, because it characterises better than any description the type which I have denoted as concrete, and the particular turn of this kind of mind, in which the abstract sense does not present itself, at any rate at the beginning.

I may also note two answers given me immediately by a celebrated painter:—*Number:* I see many brilliant points. *Law:* I see parallel lines. (Is this the unconscious idea of levelling by the law?)

The terms *goodness* and *virtue* suggested answers which are easily summarised: they fall into two categories. (1) Nothing; this answer does not belong to the concrete type; (2) a definite person, who was al-

ways named and who thus becomes the incarnation, the concrete representation.

Nearly all the images evoked belong to the visual sense; the word *force*, however, most frequently called up pure muscular images, or the same accompanied by a vague visual representation. Example—Seeing somebody lifting a weight; I vaguely see something pulling; a weight suspended by a ring; a string drawing on a nail; pressure of my fist in a fluid; the Marshal of Saxony breaking an *écu* of six pounds, etc.

I have been describing the ordinary and principal form of the concrete type. It consists in the immediate and spontaneous substitution of a particular case (fact or individual) for the general term. In certain observations a slightly different *variation* may be detected; I have encountered it among several historians and learned men. In the ordinary type, the whole (general) is thought by means of the part (concrete); in the variation, the thinking is by analogy, and the mechanism seems to be reduced to pure association. A few examples will explain the distinction. The replies in duplicate were given by different persons. *Number:* the "Language of Calculation," Pythagoras. *Cause:* Hume's theory of causality; Kant's theory. *Law:* the "Tables of Malaga," Montesquieu's definition. *Color:* the chemistry of the spectrum. *Justice:* Littré's definition. *Animal:* the περὶ ψυχῆς of Aristotle. *Time:* a vague metaphysical theory. *Relation:* discussion of Ampère and Tracy on this subject. *Infinity:* books on mathematics. *Color:* treatises of photography, etc.

It might be objected that there is a certain association in ordinary cases as in these; but the distinction will readily be perceived. The former proceed from

that which contains, to the content—from the class to the fact: they think the whole by means of the part; there is an internal association. The latter form associations beside and from without. Apparently these do not reach to the concrete, they stop half way; for a complete generality they substitute a semi-generality. Further than this, my data are neither sufficiently numerous, nor clear enough, for the point to be insisted on.

2. Visual Typographic Type. Nothing is easier to define. In its pure form it consists in seeing printed words and nothing more; in three cases words were seen *written*. Among some the vision of the printed words was accompanied by a concrete image as in the first type, but only for semi-concrete concepts (dog, animal, color); for the higher abstracts (time, cause, infinity, etc.) the typographical vision alone exists.[1] This mode of representation is widely distributed among those who have read much; but there are many exceptions.

No doubt many of my readers will discover from self-observation that they belong to this type. I have further noticed that all who have this mode of representation regard it as normal, and necessary, in anyone who knows how to read. This is a fallacy. I do not possess it myself in the faintest degree, and have met many others who resemble me.

Thus I was little prepared to discover this type; and had even reached my thirtieth observation without suspecting it, when I encountered such a clear case as to put me on the track. I was interrogating a well-known physiologist. To every word except

[1] For the word *infinity*, those who fall under this type see the printed word, or the mathematical sign ∞.

*Law* and *Form*, he replied "I see them in printed characters" and was able to describe these accurately.

Even the words *dog*[1], *animal*, *color*, were unaccompanied by any image. He volunteered further information which may be reduced to the statement, "I see everything typographically." The same holds good for concrete objects. If he hears the names of his intimate friends whom he meets every day, he sees the names printed; it is only by an effort of thought that he sees the image. The word "water" appears to him as if printed, and he has no vision of a liquid. If he thinks of carbonic acid, or nitrogen, he sees indifferently either the words printed or the symbols $CO_2$, N. He does not see the complex formulæ of organic chemistry, but the words only.

Surprised (from the reasons above indicated) at this observation—of the sincerity and precision of which there could be no doubt—I continued my investigation, and discovered this mode of thinking in general terms to be sufficiently common. Several cases indeed were as pure and as detailed as the one just cited. Thenceforward I adopted the habit of invariably asking at the close of my interrogatory "Did you see the words printed?"

Several people remarked that they had read a great deal, and corrected many proofs, and that this would account for their belonging to the typographical visual type. The influence of habit is certainly enormous, but is no adequate explanation here, since there are many exceptions. I have myself read and corrected many proofs, but no word ever appeared in my consciousness as printed, unless after considerable effort,

[1] It should be noted that he lived among these animals and experimented with them almost daily.

and then vaguely. Hence this mode must be due in great part to natural disposition.

Among the compositors questioned I found: (1) That they saw my fourteen words printed in some special type, which they occasionally specified; (2) they had a concomitant image for semi-concrete terms; (3) for abstract terms no image accompanied the typographical vision. Here we have the superposition of two types: the one natural, and of primitive formation (concrete type), the other acquired, and of secondary formation (typographical visual type).

In short,—in many minds the existence of the concept is associated with a clear vision of the printed word and nothing beyond it.

3. Auditory Type.—In its pure form this seems to be rare. It consists in having in mind nothing but signs (auditory images) unaccompanied either by the vision of printed words or by concrete images. Possibly it may preponderate among orators and preachers; of this I have no documentary evidence. Musicians do not appear to belong to this type.

One very clear and complete case of the kind I have, however, encountered. This was a polyglot physician known as the author of several works, who for many years had lived among books and manuscripts. He has no trace of typographical vision, but all words "sound in his ear." He can neither read nor compose without articulating; as the interest of his book or work grows upon him he speaks aloud—"He must hear himself." In his dreams there are few or no visual images; he hears his voice and that of his interlocutors: "His dreams are auditory." None of my words, even when semi-concrete, evoked visual images.

In most cases the auditory type is not clear. For very general terms the heard word alone exists, but in proportion as the concrete is approached, the sound is accompanied by an image; thus returning upon our former type.

It is worth while to note that the term *flatus vocis* "*nomina*," first employed in the Middle Ages and which has since become the formula of Nominalism, seems by its nature to indicate that it was originally invented by persons who belonged to the auditory type, and I may even hazard an hypothesis. The typographical visual type did not exist (printing not being invented); it is true that a substitute might have existed in the *graphic* visual type (reading of manuscripts). But considering that in the Middle Ages instruction was essentially oral, that learning came rather through listening than by reading, that the oratorical jousts and arguments were daily and interminable, it is undeniable that the conditions for developing the auditory type were highly favorable here.

I need hardly say that the three types described above are rarely met with in the pure and complete form. As a rule a mixed type prevails: a concrete image for certain words, and typographical vision, or auditory images, for others. To sum up: all cases seem to be capable of reduction to the following: (1) The word heard; beyond this, *nil* (we shall subsequently have to examine this "nothing"); (2) typographical vision alone; (3) the same, accompanied by a concrete image; (4) the word heard, accompanied invariably by a concrete image.

4. Prior to the commencement of this inquiry I felt much hesitation on one point: should one in questioning use general *words* or general *propositions*? I

decided in favor of words because these are brief, simple, isolated, and undisguised, and have the advantage of being understood directly, while they in no way suggest to the subject what line he is to follow.

I still however felt scruples in the matter. Was not the investigation as conducted on these lines a little artificial? In point of fact, general terms most frequently occur as members of a phrase, co-operating with others, and connected with them by certain relations. I therefore recommenced my inquiry, using the same method, but replacing words by phrases. The general propositions employed are purposely trite, to avoid contradiction, and to ascertain the immediate mental state. They were as follows:

Cause invariably precedes effect.—Infinity has several meanings.—Is Space infinite?—Has Time any limits?—Law is a necessary relation.—I need not enlarge upon the results: they are *precisely the same* as for words. In every case, and for each person, there is one predominating word which absorbs all the content of the phrase, and is a substitute for it. On this the instantaneous mental operation is concentrated.

If of the concrete type, the subject sees images. In the second phrase, e. g., everything converges on the word *infinity*. Replies: Sensation of obscurity and depth, vague luminous circles, a sort of cupola, a never-receding horizon, etc. If a typographic visualist, the printed sentence is seen less clearly than the simple words: "in minute characters; no capitals"; some persons glimpse it rapidly: others see only "the principal word printed."

For the pure auditory type, the answer is always very simple. "I hear the sentence, I see absolutely nothing."

The new method therefore simply confirms the previous observations, with no variations. This identity of result seems to me to militate against a distinction admitted by many authors. In the classical treatises a distinction is made between "necessary ideas" and "necessary truths" (I use their terms uncritically), i. e., general concepts and general propositions. Example: cause, principle of causality. In my opinion there is merely a difference of form between the two positions, the one psychological, the other logical. A concept is a judgment in a state of envelopment, or of result. The proposition is a word in the state of development. The difference is not material, but formal; it is the passage from synthesis to analysis.

I thought that after an interval of two years it might be interesting to repeat the same inquiry on the same people; but the results were not encouraging in this direction. Some, remembering the previous investigation, declared that "they felt themselves influenced beforehand." Others, who had a more vague recollection (perhaps because they did not understand the object of the inquiry) gave answers analogous to their former replies. In short, notwithstanding the lapse of time, and change of circumstances, each seemed to be consistent with his former self.

I must admit that in the preceding research the psychological nature of the concepts was studied under a particular aspect. This objection was made at the London Psychological Congress[1] by the Presi-

[1] The results of the investigation were published, partly in the *Revue Philosophique*, October, 1891, partly at the International Congress of Psychology, second session, London, 1892 (*International Congress of Experimental Psychology*. London: Williams & Norgate, pp. 20, et seq.).

dent, Professor Sidgwick, whose remarks may be summarised as follows :

First, Professor Sidgwick believes that the act of suddenly calling attention to a word, in a person not accustomed to introspective observation, evokes a response which does not exactly correspond to the state ordinarily aroused by such words. In his own particular case he has found that the images evoked (usually visual) were extremely feeble, but that when he dwelt upon them they were enlivened. Secondly, the images vary a great deal according to the terms employed ; for example, when he is occupied with mathematical and logical trains of thought, he sees only the printed words. If he is engaged upon the subject of political economy, the general terms sometimes have for their concomitants extremely fantastic images : like *value*, for instance, which is accompanied by the indistinct and fragmentary image of a man placing something upon the pan of a balance. Thirdly, when for such words as *infinity*, *relation*, etc., the subject answers *nothing*, the only conclusion justified is that the subject is incapable of describing the confused elements which exist in his consciousness. Fourthly, Professor Sidgwick's own experience points to the conclusion that my types may succeed each other in the same person.

On this last point—the co-existence of several modes of conception in the same person—I am quite in agreement with Professor Sidgwick, and my own data, drawn up from personal observations, would provide me with sufficient evidence. At the same time the object of my investigation was not to determine the manner in which each individual conceives, but the forms under which men as a whole think of

concepts. Nor did I profess to follow the work of the mind when it resolves its general ideas into concretes, when it makes coin out of its bank-notes, but only to seize the subjacent labor that accompanies the current and facile use of general terms, in speaking, listening, reading or writing. No doubt it would be advisable to treat the subject in another manner by studying—no longer the momentary state that corresponds with the presence of the concept in consciousness—but the stable organised turn of mind due to a long habit of dealing with concepts. To this end it would be desirable more especially to question mathematicians and metaphysicians. My data are neither numerous nor clear enough to permit of my hazarding any dictum on this subject. Some mathematicians have told me that they *invariably* require a figured representation, a construction, and that even when these are considered as purely fictitious their support is indispensable to the train of reasoning. *Contra* those who think geometrically, there are others who think algebraically, eliminating all configuration, or construction, and proceeding by simple analysis with the aid of signs: which (with the necessary corrections and descriptions) would bring the first under the concrete, and the second under the audito-motor type. Among metaphysicians the typographical visual type seems largely to predominate. One (who is well known) belongs to the pure auditory type. All this, however, is inadequate; the investigation would have to be followed out, by and upon others.

A young Russian doctor, M. Adam Wizel, who was interested in the subject, put the same questions (following the method indicated above) to persons in the hypnotic state. Admitting the unconscious mental

activities to preponderate in this state he asked whether by this procedure it would not be possible to penetrate farther into the unknown substrate of consciousness. His experiments were undertaken at the Salpêtrière, in Charcot's, clinique, upon six women—hysterics of the first order. The subjects were first put into a state of somnambulism, then after a preliminary explanation were questioned, as above. After getting the answers Wizel ordered the subjects to forget all that had happened, and then woke them. He now began again in the waking state, asking the same questions, so that he was able to compare the answers given successively in the two cases. They are nearly always clearer and more explicit during somnambulism than during the waking state, as may be judged by the following example (taken from the third observation):

| QUESTIONS | SOMNAMBULISM | WAKING STATE |
|---|---|---|
| Dog: | A big grey animal | Nothing |
| Form: | A red cardboard head | Nothing |
| Law: | A tribunal | Nothing |
| Justice: | A magistrate | State of justice |
| Number: | Figure 12 in white | The number of a note (?) |
| Color: | Green | Blue |

Where the replies are concrete in the two cases I note a tolerable analogy between them. M. Wizel (who eliminated all doubtful cases, and any accompanied by crises) never encountered the typographical visual type, nor the pure auditory type, in his experiments. His six hysterics belong to the concrete type, with the predominance of *visual* images—much more rarely of motor images, provoked by the word "force." The answer "nothing" is very frequent; less so, however, during somnambulism than during the waking state.

II.

We now reach the most obscure and difficult part of our subject. Among the nine hundred and odd replies collected, the one most frequently met with is "nothing." There is no observation in which it does not occur at least once: in the majority of cases it is found one, two, three, four, or more times. If I take the word *cause*, the formula "I have no representation," forms fifty-three per cent. of the total of answers collected; the rest saw the printed word or some concrete image; e. g., a stone falling, horses drawing, or other simulacra, of which several have already been enumerated. It is the same with all the other highly abstract terms (time, infinity, etc.). So that to return to the question which was to be the *exclusive* object of our investigation,—"Is the general idea when thought, read, or heard, accompanied by anything in consciousness?"—we may reply, an image, a typographical vision, or nothing. We must now inquire, what this *nothing* is, for it must be something.

We are face to face with the problem which the pure Nominalists attacked, when they took this *nil* in its proper sense. Were there indeed any who really pretended that we could have in mind words, and words only—nothing besides? This is a historical problem into which it is useless for us to enter. It is possible that some may have pushed their reaction against the extravagances of realism even to this point, but the thesis is totally insupportable; for at that rate there would be no difference between a general term, and a word of any unknown language: the latter is the pure *flatus vocis*, a sound that evokes

nothing. If, on the other hand, by word we mean sign, everything changes, since the sign implies and envelops something. Such appears to me to be the true interpretation.[1]

So that for the cases which alone concern us for the moment, i. e., those in which the reply was "Nothing," there are two elements, the one existing in consciousness (word heard or auditory image), the other subconscious, but not therefore invalid and inaccurate. Hence we must penetrate into the obscure region of the unconscious, in order to apprehend the something which gives to the word its signification, its life, its power of substitution.

Leibnitz wrote: "Most frequently, e. g., in any prolonged analysis, we have no simultaneous intuition of all the characteristics or attributes of a thing: in their place we use signs. In actually thinking, we are accustomed to omit the explanation of these signs by reference to what they signify—knowing or believing that we have this explanation in our power: but we do not judge the application, or explanation, of the words to be positively necessary. . . . I have termed this method of thinking, blind or symbolic. We employ it in algebra, in arithmetic, and in fact universally:" which is equivalent to saying that potential knowledge is stored up beneath the general or abstract terms; nor should we be surprised at finding this doctrine in the man who first introduced the idea of the unconscious into philosophy.

[1] Thus Taine, who is usually regarded as a Nominalist, tells us that, "A general idea is a name, nothing more than a name, a name which *signifies* and *comprehends* a sequence of similar facts, or class of similar individuals, accompanied usually by the sensory but vague representation of some of these facts or individuals." (The words italicised for emphasis are not so distinguished in the text.)

To determine the rôle of this inevitably active, albeit silent, factor is a difficult enterprise, and one that is necessarily inaccurate,—since it amounts to the translation of obscure and enveloped states into the clear and analytical language of consciousness. The simplest procedure is to examine how we arrive at the comprehension of general terms.[1] Set a page of a philosophical work before the eyes of a novice or of a man wholly ignorant of the subject. He understands nothing. The only method that will render it intelligible is to take the general or abstract terms one after the other, and translate them into concrete events, into facts of current experience. This labor demands an hour or two. In proportion to the progress of the novice, the translation is effected more quickly; it becomes superfluous for certain terms; and finally but a few minutes are required for the comprehension of a page. Untrained minds are often surprised, on reading a sentence consisting of abstract terms, at understanding each word, and yet not knowing what the whole means. This signifies that they have not beneath each word potential knowledge sufficient to establish a connexion or relation between all the terms, and giving meaning to them. Apart from those who are familiar with abstraction by natural gift or by habit, it is incontestable that to the vast majority the reading of an abstract page is a slow and painful and very fatiguing process. This is because each word exacts an act of attention, an effort, which corresponds to labor in the unconscious or sub-conscious regions. When this labor becomes useless, and we

[1] We are dealing only with comprehension, and not with invention (discovery of a law, or of general features in nature). Invention requires quite different mental processes.

think, or appear to think, by signs alone all goes rapidly and easily.

In short, we learn to understand a concept as we learn to walk, dance, fence, or play a musical instrument: it is a habit, i. e., an organised memory. General terms cover an organised, latent knowledge which is the hidden capital without which we should be in a state of bankruptcy, manipulating false money or paper of no value. General ideas are habits in the intellectual order. Suppression of effort corresponds with perfected habit; as again with perfect comprehension.

What occurs each time we have in consciousness merely the general term, is only a particular case of a very common psychological fact: as follows:—The useful work is carried on below consciousness, and above its surface only results, indications, or signs appear. The facts enumerated above are all taken from motor activity. Their equivalents abound in the domain of feeling. The "causeless" states of joy or sorrow, which are frequent in the sound man, and still more in the invalid, are only the translation into consciousness of ignored organic dispositions operating in obscurity. What gives intensity and duration to our passions is not the consciousness we have of them, but the depth of the roots by which they plunge into our being, and are organised in our viscera, and subsequently in our brain. They are no more than the expression of our constitution, permanent, or momentary. We might run over the whole province of psychology, with variations on the same theme. I do not propose to do so here, but would simply recall that every state of consciousness whatsoever (percept, image, idea, feeling, passion, volition) has its sub-

strate; that the concept reduced to the bare word is but another case of the same kind, and in no wise peculiar: that to believe that there is nothing more than the word, because it alone exists in consciousness, is to seize only the superficial and visible part of the event,—perhaps, all things considered, the least part. This unconscious substratum, this organised and potential knowledge, gives not merely value, but an actual denotation to the word,—like harmonics superadded to the fundamental note.

To conclude: we think not with words in the strict sense (*flatus vocis*) but with signs. Symbolic thought, which is a purely verbal operation, is sustained, coordinated, vivified, by potential knowledge and unconscious travail. To this it must be added that potential knowledge is a genus, of which the concept is only a species. All memory can be reduced to latent knowledge, organised, susceptible of revival, but all memory is not material for concepts. The man who knows many languages even when not speaking them, the naturalist capable of identifying millions of specimens while not classifying them, have a very extended potential knowledge, but it is all concrete. The potential knowledge which underlies concepts consists in a sum of characters, qualities, extracts, which are the less numerous in proportion as the concept approximates to pure symbolism: in other terms what underlies the concept is an abstract memory, a memory for abstracts.

In my opinion, a large measure of the obscurities and dissensions which prevail as to the nature of concepts, arises from the fact that the rôle of unconscious activity has for centuries been misunderstood or forgotten,—psychology having confined itself ex-

clusively to consciousness: and while its action is universally admitted to-day for all other manifestations of mental life—instincts, percepts, feelings, volition, etc.—it is still excluded from the domain of concepts. The whole of the foregoing discussion is an essay towards its reintegration.

Need we add that the opinion adopted as to the nature of the unconscious matters little in the present connexion? On this point there are, we know, two principal hypotheses. According to the one it is a purely physiological event, and can be reduced to unconscious cerebration. According to the other, the unconscious is still a psychical fact; whether it be an affective rather than a representative state, or a complex of little, scattered consciousnesses, isolated, evanescent, with no linkage to the self, or, again, an organisation or sequence of states, which forms another current coexistent with that of clear consciousness. These theories, and others which I omit, have nothing to do with our purpose. It is sufficient to recognise unconscious activity as a fact, without any explanation, and this position would seem to be incontestable.

We have seen that abstraction, in proportion as it ascends and strengthens, separates itself more and more from the image, until finally, at the moment of pure symbolism, the separation becomes antagonism. This is because there is fundamentally, and from the outset, an opposition of nature and procedure between the two. The ideal of the image is an ever-growing complexity, the ideal of abstraction an ever-growing simplification, since the one is formed by addition, the other by subtraction.

To the man who is gifted with a rich internal

vision, the shape of people, of monuments, of landscapes, surges up clearly and well defined: under the influence of attention, and with time, details are added,—the representation completes itself, and approaches more and more completely to the reality. So too with internal audition: witness the musician who hears ideally every detail of a symphony.

The contrary holds for abstraction. "There is," says Cournot, "an analysis which separates objects, and an analysis which distinguishes without isolating them. The use of the refracting prism is an instance of the analysis which separates or isolates. If, instead of isolating the rays so as to cause them to describe different trajectories, they are made to traverse certain media which have the property of extinguishing a definite color, we are able to distinguish without isolating."[1]

Abstraction belongs to this last type, with intervention of the process described by Cournot. Attention brings a feature into relief; inattention, and voluntary inhibition, act as extinguishers to the other characteristics.

Let us pass from theory to practice. This antagonism is of current observation, almost a banality, whenever men of imagination are confronted with abstract thinkers. We must of course exclude those who by a rare gift of nature (Goethe), or by the artifice of education, are capable of handling the image and concept alternately.

Let us take the artists as type of the imaginative thinker: the novelist, poet, sculptor, painter, musician, etc. Each dreams of an organic, living work, a *complex*. Some with words, others with forms, others

[1] Cournot, *Essai sur les fondements de nos connaissances*. I., § 109, p. 231.

with sounds; realists with the aid of minute detail, classics by means of general sketches; all make for the same end. Music again, which from its nature seems a thing apart, is an architecture of sounds of amazing complexity, often exciting contradictory states of mind.

Among abstract thinkers (theorists, scientists) the tendency is always towards unity, law, generalities—towards *simplification:* by what is fundamental and essential, if the man be genuine; by shifting and accidental features, if he is a charlatan. The mathematician and the pure metaphysician have usually a distaste for facts, for multiplicity of detail. A writer whose name has escaped me says: "Every scientist smells of the cadaver." This is our thesis, under the form of an image. Abstract thought is a cadaver. It would be more just, though less picturesque, to say a skeleton; for scientific abstraction is the bony framework of phenomena.

The antagonism between the image and the idea is thus fundamentally that of the whole and the part. It is impossible to be at the same time an abstract thinker and an imaginative thinker, because one cannot simultaneously think the whole and the part, the group and the fraction; and these two habits of mind while not absolutely exclusive are antagonistic.

* * *

In conclusion, have we general ideas, or merely general terms? It must first be remarked that the expressions, "general ideas or notions," "concepts," are equivocal or rather multivocal. We have seen that concepts differ widely in their psychological nature according to their degree, having but one characteristic in common—that of being extracts. It is there-

fore chimerical to attempt to include them all under a single definition. To take the highest only, as most frequently debated, some say, "There are no general ideas but only general terms." To others the general idea is only an indefinite series of particular ideas, or "a particular idea that the mind proposes as the first stake in a forward march."[1] To others it is a system of tendencies accompanied or not by the possibility of images.[2] For my own part I prefer the formula of Höffding[3]: "General ideas exist therefore in the sense that we are able to concentrate the attention on certain elements of the individual idea, so that a weaker light falls on the other elements."

This is the sole mode of existence that can be legitimately conceded to them.

In regard to the higher concepts we have endeavored to show that they have their distinctive psychological nature: on the one hand a clear and conscious element which is always the word, and sometimes in addition the fragmentary image; on the other an obscure and unconscious factor,—without which, nevertheless, symbolic thought is only a mechanism turning in the air, and producing naught but phantoms.

1 Dugas. *Du Psittacisme et de la pensée symbolique*, pp. 121 et seq.

2 Paulhan. *Revue philosophique*. July, 1889, pp. 77 et seq.

3 Höffding. *Psychologie*. Eng. tr., p. 168.

# CHAPTER V.

## EVOLUTION OF THE PRINCIPAL CONCEPTS.

AFTER this general study of the nature of the most elevated forms of abstraction, we must take the principal concepts one by one, and retrace their evolution in outline. Let us once more note that we are concerned with pure psychology, and are to eliminate all that depends on the theory of knowledge and other transcendental speculations. As regards the *first* origin of our notions of time, space, cause, etc., each may adopt the opinion that pleases him. Whether we admit the hypothesis of *à priori* forms of the mind (Kant), or that of an innate sense acquired by repetition of experience in the species, and fixed by heredity in the course of centuries (Herbert Spencer), or any other whatsoever—it is clear that the appearance of these concepts, and the data of their evolution, depend on experimental conditions, and consequently fall within our province. Accordingly it is with their empirical genesis, and development through experience, that we are concerned—and with that alone.

### SECTION I. CONCEPT OF NUMBER.

The lower phases of this concept are already known to us. We have traversed them in considering nume-

ration, in brutes, children, and aborigines. And here we return to it finally under its higher aspects.

At the outset, counting was, as we found, merely the perception of a plurality; abstraction being practically at zero. Later on a rudiment of numeration appeared, under a practical concrete form: we have perception plus the word—a poor auxiliary, whose part is so insignificant as to be mostly negligible. We noted the different stages of this concrete abstract period, marked by the increasing importance of the word. Finally we arrived at the point at which it is the prime and almost the only factor. Number under its abstract form, as it results, from a long elaboration, consists in a collection of unities that are, or are reputed, similar. We have therefore first to examine how the idea of unity is formed. Next by what mental operation the sequence of numbers is constituted, lastly what is the part played by the sign.

I. To common sense nothing appears more easy than to explain how the idea of unity is formed. I see a man, a tree, a house; I hear a sound; I touch an object; I smell an odor, and so on: and I distinguish this single state from a plurality of sensations. John Stuart Mill seems to admit that number (at least in its simplest forms) is a quality of things that we perceive, as white, black, roundness, hardness: there is a distinct and special state of consciousness corresponding to one, two, three, etc.

Even if we admit this very doubtful thesis, we should arrive at last only at *perceived* numbers, with which consistent and extended numeration is impossible. It can only be carried on with homogeneous terms, i. e., such as are given by abstraction.

The notion of unity must however find its point of

departure in experience, at first under a concrete form. Although it may enter consciousness by several doors, some psychologists, with no legitimate reason, have attributed its origin to one definite mode of external, or even internal, perception which they have chosen to the exclusion of all others.

For some, it is the primordial sense, *the* sense *par excellence*; touch. The child regards as a unity the object which it can hold in its hand (a ball, a glass), or follow uninterruptedly in all its boundaries. Wherever his operations are interrupted, where there are breaks of surface continuity, he perceives plurality. In other terms unity is the continuous, plurality is the discontinuous. Numerous observations prove that children actually have a far more exact and precocious notion of continuous quantity (extension), than of discontinuous, discrete quantity (number).[1]

For others, it is sight, for which all that was said above may obviously be repeated. The retina replaces the cutaneous surface: an image clearly perceived without discontinuity is the unity; the perception of simultaneous images leaving intermediate lacunæ in the field of vision, gives plurality.

The same may be said of the acoustic sensations. Preyer, in a work on "Arithmogenesis," claims that "hearing takes first rank in the acquisition of the concept of number." Number must be felt before it

[1] Maclellan & Dewey (*Psychology of Number and Its Application to Methods of Teaching Arithmetic*, New York, 1895) made pedagogical deductions from this fact. They ask, for beginners, that the examples should be borrowed from continuous quantity, and that number be considered as a particular species of measure.—In his book *Our Notions of Number and Space* (Boston, 1894) Nichols, taking a theory of James about judgments of number as the basis of his experiments, tries to show that the simultaneous sensation of two points applied to the skin originates in the successive sensation of a distinct contact upon two separate tactile circles.

is thought. Ideas of number and of addition have to be acquired, and this, according to him, takes place in the child when it hears and compares sounds. Subsequently, touch and sight complete this first outline. It is known that Leibnitz assimilated music to an unconscious arithmetic. Preyer reverses the proposition and says: *Arithmetica est exercitium musicum occultum nescientis se sonos comparare animi.*[1]

As against those who seek the origin of the idea of unity in external events, others attribute it to internal experience.

Thus it has been maintained that consciousness of the ego as a monad which knows itself, is the prototype of arithmetical unity. Obviously this assertion is open to numerous objections. To wit, the late formation of the notion of the ego, the fruit of reflexion; its instability,—still more, this unity, like all the preceding, is concrete, complex; it is a composite unity.

The thesis of W. James is very superior: "Number seems to signify primarily the strokes of our attention in discriminating things. These strokes remain in the memory in groups, large or small, and the groups can be compared. The discrimination is, as we know, psychologically facilitated by the mobility of the thing as a total. . . . A globe is one if undivided; two, if composed of hemispheres. A sand heap is one thing, or twenty thousand things, as we may choose to count it."[2] This reduction to acts of attention brings us back definitely to the essential and fundamental conditions of abstraction.

Save this last, the hypotheses enumerated (and in-

[1] I do not insist on any such rash thesis. A discussion of it will be found in the *Report of the Int. Congress of Exp. Psychol. in London* (*cit.*, pp. 35–41).

[2] *Psychology*. II., p. 653.

ternal sensation might also have been invoked; e. g., a localised pain as compared with several scattered pains) give only percepts or images, i. e., the raw material of abstract unity. This is itself a subjective notion. We said above (Chapter II) that the question whether consciousness starts from the general or the particular is a misstatement, because it applies to the mind which is in process of formation, categories valid only for the adult intelligence. So here. At the outset there is no clear perception of primary unity and subsequent plurality, or *vice versa*: neither observation nor reasoning justifies an affirmation. There is a confused, indefinite state, whence issues the antithesis of continuous and discontinuous, the primitive equivalents of unity and plurality. It took centuries to arrive at the precise notion of abstract unity as it exists in the minds of the first mathematicians, and this notion is the result of a *decomposition*, not of any direct and immediate act of postulation. It was necessary to decompose an object or group into its constituent parts, which are or appear to be irreducible. Then a new synthesis of these parts was required to re-constitute the whole, in order that the notion of relation between unity and plurality should be perceived clearly. It cannot be doubted that for the lesser numbers two, three, four, the successive perception of each separate object, and then of the objects apprehended together at a single glance, has aided the work of the mind in the conception of this relation. We have seen that many human races never passed beyond this phase. The abstract notion of unity is that of the indivisible (provisory). It is this abstract quality of the indivisible, fixed by a word, that gives us the scientific idea of unity as opposed to the vulgar

notion. Perceived unity is a concrete, conceived unity is a quality, an abstract; and in one sense it may be said that unity, and consequently all abstract number, is a creation of the mind. It results like all abstraction from analysis—dissociation. Like all abstraction, it has an ideal existence; yet this in no way prevents it from being an instrument of marvellous utility.

II. It is owing to this that the sequence of numbers, homogeneous in material, can be constituted; for the identity of unities is the sole condition in virtue of which they can be counted, and the scant numerations of the concrete-abstract period transcended. The sequence is constituted by an invariable process of construction, which may be reduced to addition or subtraction. "Thus the number 2, simplest of all numbers, is a construction in virtue of which unity is added to itself; the number 3 is a construction in virtue of which unity is added to the number 2, and so on in order. If numbers are composed by successively adding unity to itself, or to other numbers already formed by the same process, they are decomposed by withdrawing unity from the previously constructed sums; and thus, to decompose is again to compose other numbers. For example, if 3 is $2 + 1$, it is also $4 - 1$. Addition and subtraction are two inverse operations whose results are mutually exclusive: they are the sole primitive numerical functions."[1]

The simplicity and solidity of this process result from its being always identical with itself, and al-

[1] Liard, *La science positive et la métaphysique*, p. 226. It should be remarked that the process by subtraction is met with even among uncivilised people, though very rarely. The plan of making numerals by subtraction, says Tylor (*op. cit*, I., p. 264), is known in North America, and is well shown in the Aino language of Yesso, where the words for 8 and 9 obviously mean "two from ten," "one from ten."

though the series of numbers is unlimited, some one term of the sequence is rigorously determined, because it can always be brought back to its point of departure, unity. In this labor of construction by continuous repetition, two psychological facts are to be noted:

1. No sooner is unity passed, in the elaboration of numbers, than intuition fails altogether. Directly we reach 5, 6, 7, etc. (the limit varies with the individual), objects can no longer be perceived or represented together: there is now no more in consciousness than the sign, the substitute for the absent intuition: each number becomes a sum of unities fixed by a name.

2. For our unity-type we substitute higher unities, which admit of simplification. Thus in the predominating decimal system, ten and a hundred are unities ten and a hundred times larger than unity, properly so called. They may be of any given magnitude: the Hindus, whose exuberant imagination is well known, invented the *koti*, equivalent to four billions three hundred and twenty-eight millions of years, for calculating the life of their gods; each *koti* represents a single day of the divine life.[1]

Inversely, we may consider the unity-type as a sum of identical parts, and represent $1 = \frac{10}{10}$ or $\frac{100}{100}$, etc. A tenth, a hundredth, are unities ten times, a hundred times, smaller than unity properly so called, but they obey the same laws in the formation of fractional numbers.

[1] "The childish and savage practice of counting on the fingers and toes lies at the foundation of our arithmetical science. Ten seems the most convenient arithmetical basis offered by systems founded on hand-counting, but twelve would have been better, and duodecimal arithmetic is in fact a protest against the less convenient decimal arithmetic in ordinary use. The case is the not uncommon one of high civilisation bearing evident traces of the rudeness of its origin in ancient barbaric life." (Tylor, *loc. cit.*, I. p. 272)

It is well for the psychologist to note the privileged position of what we term the unity-type, or simply 1. It originates in experience, because unity, even when concrete, and apprehended by gross perception, appears as a primitive element, special and irreducible. So long as the mind confines itself to perceiving or imagining, there is in the passage from one object to two, three, or four objects, or inversely in the passage from four objects to three, two, or only one, an augmentation or diminution. But below unity in the first case, and above unity in the second, there is no longer any mental representation; unity seems to border on nonentity and to be an absolute beginning.

From this privileged point the mind can follow two opposite directions, by an identical movement: the one towards the infinitely great, with constant augmentation; the other towards the infinitely small, with constant diminution—but in one sense or the other, infinity is a never exhausted possibility. Here we reach the much disputed question of infinite number: psychology is not concerned with this. For some, infinite number has an *actual* existence. For others, it only exists potentially, i. e., as an intellectual operation which may, as was said above, add or subtract, without end or intermission.[1]

III. The importance of signs, as the instruments of abstraction and generalisation, is nowhere so well shown as in their multiple applications to discrete or continuous quantity. The history of the mathematical sciences is in part that of the invention, and use of symbols of increasing complexity, whose efficacy is clearly manifested in their theoretical or practical

[1] For the most recent view of this discussion, with the arguments on either side, see Couturat: *De l'Infini mathématique* (1896). 2nd part. Bk. III.

results. In the first place, words were substituted for the things that were held to be numerable; next, particular signs, or figures; later still, with the invention of algebra, letters took the place of figures, or at any rate assumed their function and part in the problem to be solved; later still, the consideration of geometrical figures was replaced by that of their equations; finally, the use of new symbols corresponded with calculations for infinitesimal quantities, negative quantities, and imaginary numbers.

These symbols are such a powerful auxiliary to the labor of the mathematicians that those among them who affect philosophy have gladly discoursed upon their nature and intrinsic value. They seem to be divided into two camps.

One faction attribute reality to the symbols, or at least incline that way. It is the introduction of the *nomina numina* into mathematics. They maintain that these pretended conventions are only the expression of necessary relations which the mind is obliged, on account of their ideal nature, to represent by arbitrary signs, but which are not invented by caprice, or by the necessity of the individual mind—since this contents itself with laying hold of that which is offered by the nature of the things. Do we not see moreover that the labor accomplished by their aid is, with necessary modifications, applicable to reality?

To the other, symbols are but means, instruments, stratagems. They mock at those who "look upon relations once symbolised as things which have in themselves an *à priori* scientific content, as idols, which we supplicate to reveal themselves" (Renouvier). Signs, whatever they may be, are nothing more than conventions: negative quantities represent a

change in the direction of thought. Imaginary numbers "represent important relations under a simple and abridged form." Symbols are an aid in surmounting difficulties, as, empirically, the lever and its developments serve for the lifting of weights. "It is not calculation," said Poinsot, "that is the secret of this art which teaches us to discover; but the attentive consideration of things, wherein the intellect seeks above all to form an idea of them, endeavoring by *analysis* properly so called to decompose them into other more simple ideas, and to review them again subsequently as if they had been formed by the union of those simpler things of which it had full knowledge."[1]

In sum: numbers consist in a series of acts of intellectual apprehension, susceptible of different directions, and of almost unlimited applications. They serve for comparison, for measurement, for putting order into a variety of things. If we compare now the two extremes,—viz., the first attempt at infantine numeration and the highest numerical inventions of the mathematician,—we must recognise the notion of number to be a fine example of the complete evolution of the faculty of abstraction, as applied to a particular case, the principal stages of which we have been able to note in bringing out the ever-increasing importance of signs.

## SECTION II. THE CONCEPT OF SPACE.

The idea of space has given rise to so many theories that it is difficult to restrain ourselves within the strict limits of psychology, and of our particular sub-

[1] Cournot, *op. cit.*, I., p. 331 et seq. Renouvier, *Logique*, I., pp. 377–394. Poinsot, *Théorie nouvelle de la rotation des corps*, p. 78.

ject. Whether or no this concept be innate, given *à priori* or derived from our cerebral constitution, we have here—setting aside all question of origin—only to inquire by what ways and means we attain full consciousness of it and determine it to be a fundamental concept.

In order to follow its development we must necessarily set out from experience ; since space, like number or time, is perceived before it is conceived. For the sake of clearness and precision, let us designate the primitive concrete data, the result of perception, as *extension*, and the concept, the result of abstraction, as *space*—properly so called.

I. At the outset what is given us by intuition is extension under a concrete form. What first becomes known to us is not space but a limited and determined extension—what the child can hold in its hand, reach by a movement of its arms, later on the room which it crosses with uncertain steps ; it is a street, a square traversed, a journey made by carriage or by train, the horizon which the eye embraces, the nebulæ vaguely seen in the nocturnal sky, etc. All this is concrete and measurable, and can be reduced to a measure, i. e., to a concrete extension such as the metre and its fractions.

These different extensions, although given by the senses, and therefore concrete, are already abstract ; since they co-exist with other qualities (resistance, color, cold, heat, etc.) from which a spontaneous analysis separates them, in order to consider them individually. This analysis is translated by the common terms, long, short, high, deep, near, far, to the right, to the left, in front, behind, etc.

By a simplification which occurred much later (for

it implies the foundation of geometry) this somewhat confused and incoherent list is replaced by a more rational analysis: height, breadth, depth, distance, position. It marks the transition from the concrete-abstract to the abstract period. It is in fact certain that before constituting itself as a science founded upon reasoning, geometry traversed a semi-empirical stage, it was born of practical needs—the necessity of measuring fields, building houses, and the rest. Moreover certain great mathematicians have by no means disdained to admit its relations with experience: Gauss called it the "science of the eye," and Sylvester declared "that most if not all the chief ideas of modern mathematics originated in observation."

Let us, without insisting further, recollect that extension is given us by touch and sight. Touch is *par excellence* the sense of extension: thus geometry reduces the problems of equality or inequality to superpositions, and all measure of extension is finally reducible to tactile and muscular sensations. The terms touch and vision ought in fact to be completely coextensive, representing not merely a passive impression upon the cutaneous surface, or the retina, but an active reaction of the motor elements proper to the sensorial organs.

The term *acoustic* space has recently come into use. Much work has been done on the semi-circular canals, leaving no doubt as to the part they play in the sense of bodily equilibrium;[1] some authors have even localised a "space-sense" in them. Münsterberg relates from his personal experience that while the vestibule

[1] For a summary of these investigations, see the chapter "Sensations of Orientation" in Prof. E. Mach's *Popular Scientific Lectures*, 3rd ed., Chicago, 1898; and for original discussions of the whole subject of space-sensations, see the same author's *Analysis of the Sensations*, Chicago, 1897.—*Trans.*

and the cochlea receive excitations whence result the purely qualitative sensations of sound (height, intensity, etc.), the semi-circular canals receive others which depend upon the *position* of the source of the sound: these excitations would produce reflexes, probably in the cerebellum, the purpose of which would be to bring the head into the position best adapted for clear audition. The synthesis of sounds, of the modifications perceived in the canals, and of the aforesaid movements (or images of movement) would constitute the elements of an acoustic space. Wundt, who opposes this theory, sees nothing more in the semi-circular canals than internal tactile organs, auxiliary to external touch.[1]

Leaving this hypothesis of acoustic space (which is by no means well-established), we know from numerous observations that the different modalities of tactile and visual extension, notably that of distance, are only known with precision after much groping and long apprenticeship.[2]

Extension under all its aspects, whether perceived or imagined, presents according to constitution, age, or circumstances, a character of variability which is in complete contrast with the stability and fixity of the

1 Münsterberg, *Beiträge zur experimen. Psychologie*, pp. 182 et seq. Wundt, *Physiol. Psychologie*, 4th ed., II. pp. 95–96.

2 This is not the place to enter into the well-known discussion between the "nativists" and the "empiricists." To the former all sensation, visual or tactile, contains from its outset a *quantum* of extension which is the primitive element, and the foundation for our spatial constructions. For the others there are only local signs, tactile or visual, and movements whose synthesis suffices to constitute all the modalities of existence. Whichever hypothesis be adopted, the extension in point is always that given by concrete data (not that of space conceived in the abstract)—directly cognised according to some, a genetic construction according to others. This discussion has no direct relation with our subject: for the full debate see Ribot's *Psychologie allemande contemporaine*, Ch. V. James (*Psychology*, II. Ch. XX.) has recently taken up the nativistic theory, giving new arguments in its favor.

concept of space. The conditions of this relativity have been exposed at length by Herbert Spencer. "A creature without eyes cannot have the same conception of space as one that has eyes; and it is the same with the congenitally blind as compared with those who are in full possession of their eyesight; and for the creature whose locomotion is rapid and powerful as compared with the creature which moves slowly and painfully. Our bodily bulk and organic dimensions also affect conceptions of space; distances which seemed great to the boy seem moderate to the man, and buildings once thought imposing in height and mass dwindle into insignificance. Without speaking of nervous subjects, who illusively imagine their bodies enormously large or infinitely small, there are also transient and momentary states of the organism which considerably modify the consciousness of space; thus, De Quincy, describing some of his opium dreams, says that "buildings and landscapes were exhibited in proportions so vast as the bodily eye is not fitted to receive. *Space swelled*, and was amplified to an extent of unutterable infinity."[1] "Deliberate analysis of their movements," says Lotze, "is so little practised by women that it can be asserted without fear of error that such expressions as 'to the right,' 'to the left,' 'forwards,' 'backwards,' etc., express in their language no mathematical relations whatever, but merely certain particular feelings which they experience when during work they perform movements in these directions."[2] In fine, the consciousness of concrete extension varies in quantity and quality with

[1] Extracted from Spencer's *Psychology*, Vol. I. § 90.

[2] Lotze, *Mikrokosmus*, II. p. 47.

the structure, position, age, and momentary condition of the feeling subject.

II. Starting from these concrete data—extension as included in our perceptions—how does the intellect arrive at the abstract notion of space?

The immense majority of men left to their own resources do not rise above a confused notion, half-concrete, half-abstract, of the properties of extension, and what Lotze says (*supra*) applies even better to their total idea of space-relations. The fundamental conception in such minds is simply the possibility of going very far in all directions, or of placing a succession of bodies one behind the other. As to limit, this operation remains vaguely undetermined. It is however translated into current parlance, e. g., "bodies are in space," and other analogues. Space is conceived, or rather imagined, as an immense sphere which encloses everything, as the receptacle of all extension. It contains bodies, as a barrel holds wine. The primitive cosmologies which yet demand a certain development of reflexion and of abstraction reveal the nature of this conception to us when they speak of the circle of the horizon, the vault of heaven, the firmament (a kind of *firm* enclosure), and other expressions which denote belief in an insurmountable limit. This conception, which is wholly imaginative at bottom, is a fine example of abstraction elevated into an entity, and the phantom thus created becomes in its turn the source of idle or badly-stated problems such as the following.

'We have never,' contends J. S. Mill, 'perceived an object, or a portion of space, without there being space beyond it, and from the moment of our birth we have always perceived objects or parts of space.

It follows from this that the idea of an object or part of space must be inseparably associated with the notion of a further space beyond it. Each moment of our life tends to rivet this association, no experience has ever interrupted it. Under the actual conditions of existence, this association is indissoluble. . . . Yet we can conceive that, given other conditions of existence, it might be possible to transport ourselves to the limits of space, and that after there receiving impressions of a kind totally unknown to our present state, we might instantly become capable of conceiving the fact and of stating the truth of it. After some experience of the new conception, the fact would seem as natural to us as the revelations of sight to the blind man whose cure is of long standing.'

This argument is founded upon an equivocation. Mill appears to admit as the basis of his discussion the semi-concrete, semi-abstract notion of space, described above; namely, that of common sense. Consequently he confounds and mixes up two perfectly distinct questions; that of Extension, the concrete fact perceived or imagined, and Space, abstract and conceived. In the case of the former, the problem is cosmological and objective, and we are not concerned with it; it is, under another form, the repetition of the discussion on infinite number,—are we, or are we not, to admit a continous, real magnitude? In the latter, the problem is psychological, subjective, relative to abstraction alone, and will be answered later on.

Up to this point, in fact, the concept of Space corresponds to the state of evolution that we have so frequently denoted as concrete-abstract. The true concept of space—of purely abstract space—was only

constituted when the geometricians (Greek and otherwise) disengaged from different extensions those essential features which they termed dimensions, showing by their science that elements thus abstracted and considered separately can be substituted for all the rest. Stallo justly observes that the geometrical elements are neither real, nor ideal, nor hypothetical; they are *conceptual*, the result of abstraction. "In the processes of discursive thought the intellect never has before it either sensible objects or the whole complement of relations which make up their mental images or representations, but only some single relation or class of relations. It operates along *lines* of abstraction, the final synthesis of whose result never yields anything more than outlines of the objects represented. During all its operations the intellect is fully aware that neither any one link in the chain of abstraction nor the group of abstract results which we call a concept (in the narrower sense of a collection of attributes representing an object of intuition or sensation) is a copy or an exact counterpart of the object represented. It is always conscious that to bring about true conformity between concepts or any of their constituent attributes with forms of objective reality, the group of relations embodied in these concepts would have to be supplemented with an indeterminate number of other relations which have not been apprehended and possibly are insusceptible of apprehension. . . ."[1]

No one imagines that there are in Nature points, surfaces, lines, volumes, such as geometry proposes

[1] Stallo, *Concepts of Modern Physics*, Chap. XIII., p. 225, *Int. Sc. Ser.*, third ed. He also gives a very concise criticism of Mill's theory of induction in geology.

them, nor that its concepts are copies of these, but it is not therefore necessary to take refuge in the *à priori*: abstraction suffices, the act, i. e., by which fundamental qualities are abstracted, to be subsequently fixed by definition. It is strange that Stuart Mill in his long and untoward discussion of this subject should content himself with saying that "we have a power, when a perception is present to our senses, or a conception to our intellect, of attending to a part only of that perception or conception."[1] In this remark upon attention he is very near recognising the rôle of abstraction (which for the rest he fails to name), but instead of insisting upon it he returns to his thesis, that "the foundation of all sciences, even deductive and demonstrative sciences, is induction . . . ."

The concept of space such as the geometers have made it, namely at its highest degree of abstraction, is thus the result of association. It is extension emptied of all its constitutive qualities, save the necessary conventions which determine it. This schema (apart from all transcendental considerations) appears to us as the total of the conditions of bodily existence in so far as they are endowed with extension. Thus constituted, with the marks which are proper to it, and distinguish it from all others, this concept, like that of number, is susceptible of multiple application, while moreover it has no assignable limits in any direction (i. e., according to the time-honored expression, it is infinite).

Just as concrete number represents real unities or collections, while abstract number detached from discontinuous realities admits of infinite numeration; so concrete space (extension) corresponds to the intui-

[1] *System of Logic*, I. Bk. II., Chap. 15, § 1.

tion of certain bodies, while abstract space, by an unrepresentable concept, if not by words, implies an unlimited extension.

If, hypothetically, it were possible to count all the leaves of all the trees in the world, this prodigious number corresponding to concrete unities would be as nothing to the mind that can count for ever beyond that. So for the extension determined by the movement of our arms or legs, by days of railway travelling or sailing, by balloon ascensions, and finally by the most powerful telescopes that can scrutinise the infinity of the heavens,—in all these concrete, fixed, *measured* extensions we can always imagine a beyond, because the end of one extension is the beginning of the next. All that, however, is but the work of the imagination manipulating abstraction. The law of construction for infinite space is the same as for infinite number: this infinity is only in the operation of our mind, it is a pure psychological process; we believe we are dealing with real magnitudes, and we are only acting upon our own judgment: we are but adding states of consciousness one upon another. Space is only potentially infinite, and this potentiality is in us, and in nothing but ourselves; it is a virtuality which can neither be exhausted nor achieved. To erect it into an entity is to reify an abstraction, to attribute an undue objective value to an entirely subjective concept. The journey to the end of space as suggested by Stuart Mill in the passage above cited (if by space he means the simple possibility of containing extended bodies) would really be a journey to the end of our minds: if he means a journey to the end of the real world, i. e., determinable and measurable extension—which has no limits beyond the imperfection of our

instruments—then he admits implicitly that the universe has bounds, he takes sides in a debate in which experimental psychology (we repeat) sees nothing, and which it is even totally incompetent to decide.

* * *

During this century certain illustrious mathematicians,—Gauss, 1792, in an unpublished work, Lobachévski in 1829, Riemann, Beltrami, Helmholtz and many others after them, constructed a new geometry known under various names: astral, imaginary, pangeometric, metageometric, and lastly non-Euclidean geometry. Its fundamental principle is that our Euclidean space is only one particular case among several possible cases, and our Euclidean geometry one species of which pangeometry is the genus—that the sole determining reason in its favor is that Euclidean geometry alone is practically applicable to, and verified by, experience. These essays, beyond their direct interest to mathematicians, have already given rise to a considerable number of philosophical considerations. While they have only very distant relations with psychology, they deserve notice, because they enable us the better to understand the genesis of the concepts of space, and are moreover a striking proof of the constructive power of the mind, emancipated from experimental data, and subject only to the rules of logic.

Our space being of three dimensions, the neogeometers speculated in the first place as to the hypothesis of a space of 4, 5, or $n$-dimensions; later on they chose as their base of operations a space of three dimensions, considered no longer as plane (Euclidean space) but as spherical or pseudo-spherical, having,

i. e., instead of a zero curvature, either a positive (spherical space) or a negative curvature (pseudo-spherical space). Their point of departure is the rejection of Euclid's postulate—they do not admit that it is impossible to draw through a point more than one parallel to a given straight line. In spherical space there is nothing analogous to the Euclidean axiom of parallels; in pseudo-spherical space two parallels to a line can be drawn through any point. In the first hypothesis, the sum of the three angles of a triangle is greater than two right angles; in the second it is smaller. Thus by deduction after deduction, the neo-geometers constructed an edifice very different from ordinary geometry, subject to no other conditions than that of being free from internal contradiction.

In our connexion, the sole utility of the invention of imaginary geometries is to have reinforced, as if by a magnifying process, the distinction between space *perceived* and *conceived*; this assumes various forms according to the process of abstraction employed and fixed in definitions. "Euclidean" space has only one advantage, that it is the simplest, the most practical, the best adapted to facts: in short, that which involves the least disparity between the ideal and our experience, and consequently the most useful. Certain neo-geometers have in fact maintained that it is uncertain whether space can, or cannot, have the same properties throughout the whole universe . . . and that it is possible that in the rapid march of the solar system across space we might gradually pass into regions in which space has not the same properties as those we know"; yet this thesis, which, fundamentally, reifies an entity, does not seem to have

gained many partisans. Stallo criticises it at length (*op. cit.*, Chap. XIII).

There is no agreement as to the measure in which the new concepts agree or disagree with the theory of space, "the *à priori* form of sensibility." Some hold them to be indifferent, others to be unfavorable to Kantism: this discussion which, for the rest, does not concern us is still in progress.

* * *

In conclusion, extension is a primary datum of perception and cannot be further reduced: it is multiple, full, heterogeneous, continuous (at least in appearance), variable, perhaps finite; while space (concept) is void, unified, homogeneous, continuous, and without limits.

Many men and races never get beyond this stage of concrete representation, which corresponds with the first moment of evolution in the individual and in the species. The first step towards the concept of space (concrete-abstract period) consists in representing it to oneself as the place, the receptacle of all bodies. This is the direct result of primitive reflexion: image rather than concept, to which the mind attributes an illusive reality.

The true concept, resultant of abstraction, has been the elaboration of geometricians. It is actually constituted by a synthesis of abstracts or extracts which are, according to Riemann, size, continuity, dimension, simplicity, distance, measure. This synthesis or association of abstracts has nothing necessary about it; its elements may be combined in several ways; hence the possibility of different concepts of space (Euclidean, non-Euclidean). Space conceived as infinity reduces itself to the power that the human mind

has of forming sequences, and it forms them thanks to abstraction, which admits of its seizing the law of their formation.

Intuition is the common basis of all concepts of space. Euclidean space rests directly upon this, and upon definitions. Non-Euclidean space rests directly upon it, but more particularly upon definitions.

Although inapplicable to the real world, these last —which are constructions in which the mind is submitted to no other laws than agreement with itself— are brilliant examples of the power of abstraction, when it attains its highest degree of development.

## SECTION III. THE CONCEPT OF TIME.

In evolving the idea of time, as in that of space, we must first examine the concrete fact which is its starting-point, i. e., real *duration*; next the concept which is extracted from it, time *in abstracto*—and this must be followed in the successive stages of its development.

### I.

Real, concrete duration is a quality known by itself, included among internal and external sensations, as later on in the representations which psychology, in what concerns it, must accept as an ultimate datum.

What is this concrete duration, furnished by experience? It might strictly be said to be the present; yet this answer is somewhat theoretical, for it must be admitted that what we term "the present" has vague and fluctuating limits. Moreover, its clear and precise distinction from what has preceded and what is to follow it—the past and the future—is a somewhat late production. Of this we have objective

witness (see Ch. II.) in primitive languages, during the period in which the value of the verbs was undetermined. Take again the fact, as frequently observed, that children even at the age of three, or older, having vague notions of past and future, make a general confusion, and do not distinguish between "yesterday" and last week, between "to-morrow" and next week (Sully).

Still, we must admit that the present has the privilege of appearing in consciousness as the typical duration, the standard, the measure to which everything must be referred. Nor can this be otherwise, seeing that (as is too often forgotten) we live only in the present; that the past and the future have no existence for us, are only known to us under the condition of becoming present, of occupying *actual* consciousness. The present is the only psychical element, which, consciously or unconsciously, gives a content and reality to duration.

It is essential to rid ourselves of the opinion accredited by many authors, that the present is only an elusive moment, a transition, a passage, a flash, a mathematical point, a zero, a nullity; on the contrary —it alone has duration, is now long, now short. It is even possible, to some extent, to determine its limits, and to transcend this vague description. Here we are aided by the labors of the psycho-physicists. We may say that this study, long restricted to metaphysical dissertations, entered upon a positive phase with Czermak, who (in 1857) opened out a new line, in which he has been followed by many others. The numerous researches and experiments made upon the "sense of time" may be omitted without prejudice to our subject, while the discussion of them would deter

us from our principal aims. We must, however, give a rapid summary of those which relate either to the actual perception of duration, or to the reproduction in memory of past duration.[1]

1. This present, declared to be inapprehensible, has however been determined as regards its *minimum* duration. For the discrimination period between two different sensations (taken as the type of the briefest and simplest psychical act), Kries and Auerbach found durations varying between 0·01 and 0·07 second with an average of 0·03 second. At a later period, Exner, experimenting with Savart's wheel, stated that the interval at which two successive taps can be perceived separately may be reduced to 0·05 second: as also for the sound produced by two electric sparks. For the eye, the minimum perceptible interval between two impressions falling on the yellow spot, is 0·044 second. Below this, one of the conditions necessary to consciousness—an adequate duration—is wanting.

Certain experiments contributed by Wundt and his pupils throw light also upon the *maximum* duration that can be apprehended by consciousness. They made use, almost exclusively, of auditory sensations, which are more closely allied than any others to the sense of time. Wundt finds that twelve impressions equivalent to a duration varying from 3·6 to 6 seconds can be clearly perceived to form a group. Dietze admits the continuous perception of 40 beats of the metronome, provided the mind arranges them spontaneously in 5 sub-groups of 8, or 8 sub-groups of 5. Total duration: 12 seconds. Others vary in their

[1] The complete history of this question, from its first beginnings to contemporaneous work, may be studied in Nichols's "Psychology of Time," *Am. J. of Psychol.*, III. pp. 453–530.

conclusions from 6 to 12 seconds and even more.[1] James is inclined to think that the actual present may extend to a *minute*.

Of course these figures, of which we can only give a few, vary with the subjects, quality of the impressions received, conditions of experience, exercise, etc. Nor must we forget that these laboratory researches are somewhat artificial, and concerned with the perception of "the present" under studied conditions of simplicity which are not precisely those of spontaneous consciousness. Still it is plain that "the present" is by no means an abstraction, a nothing, and we may conclude, in the words of James, "by saying that we are constantly conscious of a certain duration—the specious present—varying in length from a few seconds to probably not more than a minute, and that this duration (with its content perceived as having one part earlier and the other part later) is the original intuition of time. Longer times are conceived by adding, shorter ones by dividing, portions of this vaguely broached unit, and are habitually thought by us symbolically."[2]

2. Experiments relating, not to consciousness of actual duration, but to the *reproduction* of durations, and determination of the errors involved, are numerous, and contradictory. I refer to them in passing only because they are eminently suited to show the very relative and precarious character of our concrete notions of duration.

Through all divergencies, the formula enunciated by Vierordt, the principal initiator of these researches,

[1] For these and the following experiments, cf. Wundt, *Physiologische Psychologie*, 4th ed., I. pp. 408 et seq.

[2] *Psychol.*, I. 642.

remains stable; our consciousness of time comes, not from a sensation, but from a judgment, and in our retrospective appreciation of duration, we diminish intervals that are long, and increase those that are short. The debates and disagreements of the experimenters relate above all to the determination of the "indifferent point." Vierordt denoted by this term the interval of time which we appreciate the most exactly, which we have no tendency to lengthen or abridge, so that if we are required to repeat it experimentally, the error is nil, or very rare. This duration, reproduced according to reality, is 0·35 sec. (according to Vierordt and Mach); 0·4 sec. (Buccola); 0·72 sec. (Wundt); 0·75 sec. (Kollert); 0·71 sec.; etc. According to another author, Glass, there is a series of points at which we find maximum relative accuracy; 1·5 sec., 2·5 sec., 3·75 sec., 5 sec., 6·25 sec., etc. Münsterberg again criticises the entire series of figures and experiments, for reasons that will be given below.

Independent of these experiments, which are restricted to very simple events, the facts of our daily life show to superabundance that our memory of duration is almost always inexact. Thus it has often been remarked that the years seem to be shorter with advancing age: which is again an instance of abbreviation of the longer intervals.[1] It is hardly necessary to say that our appreciation of duration (concrete), like that of extension (concrete), depends upon multiple conditions, and varies with these. Such are preeminently constitution and temperament: compare a

[1] M. Janet has studied this subject, under the title "Une illusion d'optique interne" (*Rev. Phil.*, 1877, III. pp. 497 et seq.) and explains the illusion by supposing that the apparent duration of a certain portion of time, in the life of each individual, is proportional to the total duration of his life.

phlegmatic with a nervous individual; an Oriental for whom time is not, with an Occidental, agitated by a feverish existence. Add to these, age, number, and vivacity of impressions received, certain pathological states, etc., and we find here, as for space, that the variability of concrete knowledge is opposed to the fixity of the concept.

This consciousness of duration, fluctuating, variable, and unstable as it may be, is nevertheless the source whence our abstract notion of time is derived: but whence comes it, itself? Where does it originate? "Time has been called an act of mind, of reason, of perception, of intuition, of sense, of memory, of will, of all possible compounds and compositions to be made up from all of them. It has been deemed a General Sense accompanying all mental content in a manner similar to that conceived of pain and pleasure."[1]

Here are many answers. We may add that among these supposed origins some authors admit only one, to the exclusion of the rest, though nothing justifies them in such arbitrary selection.

Some prefer *external* sensations, inasmuch as they give us the consciousness of a sequence. Hearing has been termed the sense of time *par excellence.* This thesis has notably been sustained by Mach:[2] since in a melody we can separate the rhythm from the sounds which compose it, he concludes that rhythm forms a distinct sequence, and that there must be in the ear, as in the eye, a mechanism of accommodation which is perhaps the organ of the "time-sense." Others decide in favor of the general sense, touch, capable in

1 Nichols, *op. cit.*, p. 502.

2 *Analysis of the Sensations*, Chicago, 1897, pp. 110 et seq.

all animals of receiving a succession of impressions at once distinct and forming a series. Sight, with its fine and rapid perception of movements and changes, is an organ admirably adapted to the formation of relations of sequence, the constitutive elements of time. Were not, moreover, the first essays at determining time (succession of days and nights, seasons, etc.) founded upon visual perceptions?

The majority of contemporary psychologists are, however, inclined with reason to seek the principal origin of the notion of duration in *internal* sensations; and these derive their prerogative from the primordial and rhythmical nature which pertains to the principal functions of life.

"A stationary creature," says Herbert Spencer, "without eyes, receiving distinct sensations from external objects only by contacts which happen at long and irregular intervals, cannot have in its consciousness any compound relations of sequence save those arising from the slow rhythm of its functions. Even in ourselves, the respiratory intervals, joined sometimes with the intervals between the heart's pulses, furnish part of the materials from which our consciousness of duration is derived; and had we no continuous perceptions of external changes, and consequently no ideas of them, these rhythmical organic actions would obviously yield important data for our consciousness of Time: indeed, in the absence of locomotive rhythms, our sole data."

"Rhythm," to quote Horwicz, "is the measure, and the sole measure, of time; a being incapable of regular periodic intervals could not attain to any conception of time. All the rhythmic functions of the

[1] H. Spencer, *Psychology*, I., § 91, p. 215.

body subserve this end: respiration, pulse, locomotor movements, hunger, sleep, work, habits and needs of whatever kind."—Guyau maintains essentially the same thesis, under a more metaphysical aspect: "Time is embryonically in primitive consciousness; under the form of force and effort; succession is an abstraction of motor effort, exerted in space. The past is the active become passive."[1]

More recently, Münsterberg[2] has attributed a preponderant and almost exclusive part to respiration. Although he affirms that the origin of our notions of duration must be sought in our consciousness of muscular effort in general, and that its primitive measure lies in the rhythm of the bodily processes; yet the gradual rise and fall of the sense of effort which accompanies the two phases of the respiratory function (inspiration, expiration) seem to him the principal source of our appreciation of duration. After a rather sharp criticism of the attempts of his predecessors (which we have already reviewed) to determine the "indifferent point," he maintains that their disagreements were caused by incomplete comprehension of the psychical events produced in the course of experience. In the perception of the successive beats of a metronome, or taps of Wundt's electric hammer, only the auditory impressions are attended to; this is a mistake. It is supposed that the sensation-limits form the entire content of consciousness, and that the intervals between them are empty. On the contrary, they are filled by an act of attention. We are conscious of a process of variable tension which, from

[1] Horwicz, *Psychologische Analysen*, III., 145. Guyau, *Genèse de l'idée du temps*, pp. 35 et seq.

[2] *Beiträge zur experimentellen Psychologie*, II., 1889.

the initial moment, goes decreasingly towards zero, and then rises again, to adapt itself to the sonorous impression that should follow it. In other words, there are, in the perception of three successive taps, not three, but *five* states of consciousness: three external and two internal sensations. We must reckon thus if we are rigorously to determine the *psychological* conditions of experience. As evidence, Münsterberg brings forward the following results, which are from his own experiments.

The "normal time" is first determined, i. e., the standard of duration that should be reproduced by the experimenter as exactly as possible ("time of comparison").

In one case, different durations were given, such as 15, 7, 22, 18 secs., etc., without attending to the respiration (expiration or inspiration) of the subject, who reacted independently of it. In the reproduction of normal time, the mean error was 10.7 per cent.

In the second case, the same numbers were given again, but care was taken that the subject began his estimation at precisely that respiratory period which coincided with the beginning of the normal time. The mean error did not now exceed 2.9 per cent.

In the two cases cited, there was no interruption between the determination of the normal time and its reproduction; the two operations succeeded each other immediately. If, on the contrary, a short pause, or arrest, was introduced between the two, varying from 1 to 60 seconds, the results are—proceeding at random as in the first case—a mean error of 24 per cent.; as in the second, a mean error of 5·3 per cent.

Münsterberg has been not unreasonably reproached for attributing to respiration, among all the other in-

ternal sensations, the exclusive privilege of measuring time. A less justifiable criticism asserts that his thesis is devoid of value because we can appreciate the variations in duration in the beats of a clock more readily than the changes in the rhythm of respiration. This is confounding two distinct factors in the genesis of the idea of duration: its period of formation and its period of constitution; that which occurs at the commencement, and that which takes place in the adult. Our measure is at first subjective, variable; progress consists in the substitution of a fixed, objective measure. Doubtless, the latter is superior in clearness and in precision; yet this is no proof, not even presumption, that it is first in order: we shall return to this point later on.

In short, our consciousness of duration is a complex state, more exactly, a process—since it is less a state than a becoming. The rhythmical visceral sensations are its core; it is an internal chronometer, fixed in the depths of our organisation. Around this subjective element, other objective elements are added and co-ordinated—the regular sequences which are caused by external sensations. They form the sheath of the core, and constitute the sensible portion of our consciousness of duration, not, however, its totality.

II.

Until now we have considered time under its concrete form alone, whether given as an actual event in consciousness, or revived as a past event in memory. We have now to follow the complete development of this idea to its extreme limit. In this study we may conveniently distinguish two stages:

The first, which depends on memory and imagina-

tion, consists in thinking a certain extension of duration, that may be more or less vaguely represented: a day, a week, a year, etc.

The second, which depends on abstraction alone, gives time in general, the pure concept, which cannot be represented, and is determined by signs alone.

First Stage.—Certain minds never get beyond this first stage. In respect of time, this corresponds to the lower forms of abstraction which we have so often designated by the terms, *generic image* and, at a higher degree, *concrete-abstract notions* (intermediate abstracts).

The lowest form, which is just higher than the recognition of concrete duration, results like the generic image from the repetition of a sequence of events that recur constantly, and are approximately uniform. They are series of which the terms are variable, but which begin and end always in the same manner. Such are the appearance and disappearance of the sun, lying down to sleep and waking up again, and similar facts of common life. The points of departure, the start and finish, are always the same, whatever the variations in the intermediate states. These generic images are met with among the higher brutes, children, and primitive races.

To what extent are the higher animals capable of having a certain representation of time, constructed from their experience of real duration? This is an obscure problem which has been little studied. We are not of course referring to time *in abstracto*, to the concept, but to the recognition of certain often repeated cycles. Many animals are known to have an approximate appreciation of sufficiently protracted periods, supplied by the periodicity of their needs

(hours at which they get food, are taken out, etc., etc.). Prejudice apart, we know of others which, in addition to this subjective physiological knowledge, possess a fairly exact notion of certain regular and objectively caused periods, determined by the progress of natural phenomena, especially by the path of the sun.[1]

In all these instances we may assign as cause, the incontestable preponderance (in animal life) of automatism and of routine: which is equivalent to saying that the notion of these durations is formed by a passive assimilation, and this—as we have seen—is the creative process of generic images.

According to some authors, there are instances of exact appreciation of much less simple periods. Brehm says that during a long passage an ourang-outang visited the sailors every Wednesday and Friday at 8 o'clock, because on those days sago, sugar, and cinnamon were served out, of which he got his share. An anecdote has often been cited after Romanes, of "the geese who came regularly every fortnight, from afar, the morning after the market, in a small English town, to pick up the corn scattered on the market-place. One year the market was postponed for a day of national humiliation, but the geese came as usual."[2]

These and other analogous facts seem scarcely sufficient in number, nor strictly enough observed, to warrant any scientific conclusion.

[1] Van Ende cites a large number of facts in point, but they are not all equally convincing. *Histoire naturelle de la croyance*, pp. 208–212.

[2] Romanes, *Animal Intelligence*, p. 314. It should be remarked that the author only reports the fact from another witness—that the narrator said it had occurred "thirty years before," and "that he did not pretend to remember under what precise circumstances the habit of coming into the street was acquired."

We have previously remarked that, up to the age of three years or more, children who already have an approximate knowledge of space relations, (distance, proximity, within, without, upper, lower, etc.) have a very confused notion of periods as short as three to four days, a week, etc. It has been hypothetically suggested that the extension of the notion of duration must for them arise in expectation rather than in memory, in an orientation towards the future rather than the past.

The concrete-abstract period with its different degrees, limited on the one extreme by generic images, on the other by the pure concept, is met with among savage races, and in rising civilisations. It is a stage that has to be traversed by every human race ; many now existing have not got beyond it. Days (solar revolution), months (lunar revolution), and seasons, the round of the changing aspects of nature, give the primitive and simplest notions of time in extension. No tribe is so low in the scale as not to have reached this level. The determination of the (solar) year, even when only approximate, marks a decisive progress.

The peculiar feature of this period, in its lowest degrees, is that the notion of time cannot as yet be separated, or extracted, from the sequence of events. We have already given many examples of this state of intelligence. It is not poetical feeling that makes the savage reckon the age of his children by the flowering of certain plants (and other analogous locutions abound among primitive races,)—nor any innate taste for metaphor : it is merely that he requires concrete marks to determine duration. He cannot think the longer periods *in abstracto* ; they must be imagined, represented in virtue of a more or less arbitrary choice,

imprisoned in a concrete mould. Moreover, in the absence of any extended, coherent, systematic numeration, the mind loses itself after the first step. It lacks the necessary vehicle for movement in front and behind, knowing whither it is tending. The natural phenomena which it takes as its starting-point are poor substitutes for the absent sign, and moreover rivet it invincibly to the concrete.

In my opinion, the culminating point of this period is arrived at in the popular conception of time—considered as a vague entity which unrolls itself, as it gives birth to events. This is the notion that is general among most men of medium culture, who are ignorant of philosophical speculation on the subject. It is the final term of common, spontaneous reflexion, left to its own resources. Thus it is said of time that it brings the unexpected, consoles sorrow, extinguishes passion, changes tastes, solves difficulties, and the like; it seems to be an active power, a thing in itself. In fact, no other abstraction has perhaps been so often reified. We may further remark that time has often been personified and even deified in several religions. Such an honor has never been conceded to space. The cause of this difference is that time has an internal, human character: above all, that it is opposed to space as dynamic to static. It is an entity manifested in movement and change, and thereby essentially acting and living. While, in the popular conception, space is the *passive* receptacle of bodies, time is the *active* spring by which the whole is set in motion.

Second Stage.—The generic images of duration, and later, the semi-concrete, semi-schematic representation of more prolonged lapses of time, provide the material whence we obtain the purely abstract con-

cept of time. It was stated above (p. 153) that the true concept of space was constituted on the day when the ancient geometers disengaged from the different extensions, the essential features which they termed dimensions. So must the first astronomers, without knowing or seeking for what they did, have laboriously disengaged the essential characteristics of time conceived *in abstracto*. First, they purified the notion of duration from all anthropomorphic features, studying it objectively, in the course of the regular phenomena of nature. Moreover, they introduced measure. The Chaldæans of Alexander's time, who possessed a series of astronomical observations embracing a period of 1,900 years, who made an error of only two minutes in their computation of the sidereal year, who determined a cycle of 6,585 days by which they were able to calculate eclipses;[1] who were later on the inventors of the clepsydra, hour-glass, and other more or less imperfect instruments for measuring the subdivisions of the day; all these counted for more than metaphysical speculation in ridding our subject of popular conceptions—or at least to a large extent prepared the way. Accustomed as we are in civilised life to a convenient and exact knowledge of the flow of time, measuring it off at any moment by clocks and watches, we forget how widely different must be the state of mind in the man whose only guides are approximations: such, e. g., as the varying height of the sun in different seasons, with other natural changes apt to be misinforming. The one life is precise, the other vague, or at least mysterious.

[1] According to Delambre, the Chaldæans could only discover the cycle which the Greek mathematicians called *saros* by studying their commemorative notes; i. e., from a considerable mass of observations, they *extracted* or *abstracted* a constant recurrence.

That our measure of time (as of aught else) is relative, matters little, and the vexed problems of this subject do not concern us. By measure, the notion of time acquires a *quantitative* mark; it no longer appears as an entity, but as a possibility of successive events, as a divisible and subdivisible process; as an extract or abstract, set apart from the events, dissociated from them by an intellectual operation: in short—time is a thing no longer real or imaginary, but *conceptual.*

It is wasted labor to repeat for time what has already been said for space, and is applicable to both concepts. Time, like space and number, can be conceived as illimitable; but here again the infinity is only in our mental operation. We can add century to century, million upon million of years. This infinite time is potential only—constituted by a two-fold process: either as a sequence of numbers, which is the ordinary, simplest, and most abstract proceeding; or by filling it with fictitious events, with arbitrary constructions, for the future; by evoking the image of vanished states, when we go back to the first geological ages of our globe, to the nebulous period, and so on. This conception of infinite time is however quite subjective, and in itself reveals nothing as to the nature of things: we do but add one state of consciousness to another; it is an inexhaustible possibility of progression and retrogression; and it is nothing more.

It is a common illusion to transform this conceived infinity into a real infinity; we forget that the mind is only working upon the abstract, i. e., upon a fiction, useful no doubt, but created by ourselves alone, according to our intellectual nature.

Let us suppose that, in consequence of gradual cooling, the disappearance of the sea, or any other cause, man and all animals capable of appreciating duration were to disappear from the surface of the earth; time would disappear with them. Doubtless the earth would continue to turn round its axis, the moon round our planet, the sun to take its course; yet nothing would exist beyond the movements. Just as—if every eye were to disappear—there would be neither light nor color; if every ear failed, there would be neither sounds nor noises, but only the bare potentiality of luminous and auditory sensations if the appropriate organs were to appear again: so, on our hypothesis, there could only be a potentiality of time.

Consciousness is the necessary condition of any notion whatever of the time which appears and disappears with it.

* * *

It is no part of our subject to discuss the various theories that have been advanced as to the nature of the psychological process by which the primitive notion of time is constituted in consciousness. This question is, on the one hand, distinct from the history of its development as an abstract idea, which we have been endeavoring to follow, and, on the other, from all hypotheses as to its ultimate origin (Kant's *à priori* form, Renouvier's law of the mind, Spencer's cerebral innateness) which explains neither its appearance as a fact, nor its genesis in experience. We may, however, complete our account by summarising the latest psychological opinions.[1]

[1] For details see, in addition to Nichols's article as previously cited, Sully, *The Human Mind*, II., Appendix E, and James, *Psychology*, I., pp. 632 et seq.

It is clear that a simple sequence of impressions will not suffice to constitute the idea of time; the series must be cognised as such, felt or thought as a sequence. How is it to be cognised? Contemporary opinion upon this point appears to be capable of reduction into two principal types.

1. Some admit, as adequate conditions, sensations and their consecutive images, strong states and weak states; provided, however, that the latter arise before the former have disappeard from consciousness.

Wundt supposes that similar beats of a clock succeed each other at regular intervals in a vacant consciousness. When the first has disappeared its image remains until the second succeeds it. This reproduces the first, in virtue of the law of association by similarity, but at the same time encounters the still persisting image. Hence the simple repetition of the sound contains all the elements of time-perception. The first sound (recalled by association), gives the commencement, the second the end, and the persistent image represents the length of the interval. At the moment of the second impression, the entire perception of time exists simultaneously, since all the elements are presented together: the second sound and the image directly, and the first impression by reproduction.

"The phenomena of 'summation of stimuli' in the nervous system prove," says James, "that each stimulus leaves some latent activity behind it which only gradually passes away. Psychological proof of the same fact is afforded by those 'after-images' which we perceive when the sensorial stimulus is gone. . . . With the feeling of the present thing there must at all times mingle the fading echo of all those other things

which the previous few seconds have supplied. Or, to state it in neural terms, *there is at every moment a cumulation of brain-processes overlapping each other, of which the fainter ones are the dying phases of processes which but shortly previous were active in a maximal degree. The amount of the overlapping determines the feeling of the duration occupied. . . . Why* such an intuition should result from such a combination of brain-processes, I do not pretend to say. All I aim at is to state the most *elemental* form of the psycho-physical conjunction." James is careful to repeat in several places that he makes no attempt at *explanation.*

2. Others admit sensations and intervals; sensations that are no longer images, but internal sensations of tension, of effort; more properly a sub-conscious element, which consciousness is able to apprehend by observation or induction. This theory has a more active character than that first discussed.

The cleanest and most complete form of this interpretation is that of Münsterberg,—as set forth above.

Fouillée supports the same thesis as a particular case of his general theory of *idées-forces.* The apparent present is a synthesis of real presents. Our primitive perception is of change, not of stability; we are conscious of transition. The static point of view must be completed by the dynamic.

The complete separation of present and past is a mathematical fiction. The sum of transition which is a factor in appetite aids in forming the series. Time is a form of appetite; beneath the floating image there is a tendency to movement. A non-volitional being would have no representation of time: time is a form of appetition.[1]

[1] Fouillée, *Psychologie des Idées-forces*, II., 81–204.

"It is probable," says Mach, "that time sensation is connected with the organic *consumption* necessarily associated with consciousness,—that we feel the *work of attention* as time. . . . The fatiguing of the organ of consciousness goes on continually in waking hours, and the labor of attention increases just as continually. These sensations connected with greater expenditure of attention appear to us to happen later."[1]

Others again (Waitz, Guyau, and more particularly Ward) admit *temporal signs* in imitation of Lotze's "local signs." Our successive acts of attention leave a series of residua, variable in intensity and precision; these "temporal signs" permit the conception of representations as successive, and no longer as simultaneous. "What is this distance that separates *A* from *B*, *B* from *C*, and so on? . . . It is probably that the residuum of which I have called a temporal sign; or, in other words, it is the movement of attention from *A* to *B*."[2]

These extracts will suffice to show the character of the second theory, which seems to me the more acceptable. It is the more complete, inasmuch as it takes into consideration, not only the clear states, existing in consciousness, but the sub-conscious states also; it is not confined to intellectual elements alone (sensations and images), but recognises the necessary rôle of the active, motor elements.

Moreover, it seems more apt than the other to ex-

[1] Mach, *Analysis of the Sensations*, English translation (Chicago, 1897), pp. 111–112.

[2] Ward, article "Psychology," in the *Encyclopædia Britannica*, Vol. XX., pp., 65 et seq.—On the metaphysics of time considered as pure heterogeneity, see the recent work of Bergson, *Essai sur les données immédiates de la conscience*, pp. 76 et seq.

plain certain facts of current experience. It is a matter of common observation that time seems long to us, under two contrary conditions: (1) when it is very long; (2) when it is very empty. Here we have an apparent psychological contradiction. The two cases, however, are equally explained by the quantity of the states of consciousness: the first is filled with events, the second, with efforts. After three or four days of a journey fertile in incident, one seems to have left home a long time, because (in comparison with three or four days of ordinary life) the quantity of adventures held in mind, each implying a *quantum* of duration, appears to us in sum as an enormous duration. On the other hand, to the prisoner incarcerated in a cell, to the traveller at a deserted station waiting for a train; briefly, to all who are in the state known by the name of expectant attention, time seems to be of immeasurable extension. This is because there is a constant expenditure of effort, a tension incessantly renewed, incessantly frustrated; consciousness is nearly void of representations, while it is filled with acts of attention constantly repeated. This instance of time prolonged, while apparently empty, is difficult to explain, if only the intellectual elements are taken into consideration, omitting the consciousness of motor states. It should be noticed that "full" time seems longer in the past; "empty" time, in the present and immediate past; perhaps because the former rests principally upon intellectual memory, which is stable; the latter, upon motor memory, which is vague and fragile.

## SECTION IV. CONCEPT OF CAUSE.

The idea of cause has for centuries been the subject of so many speculations, that our first care must be to confine ourselves scrupulously to our subject, i. e., to retrace its evolution simply, marking the principal phases of its development in the individual and the species, while as far as possible eliminating whatever lies outside this one question.

It has been remarked that the word cause signifies sometimes an antecedent, sometimes a process, sometimes antecedent, process, and effect produced, taken all three together.[1] This last sense alone is complete. For, if the primitive, popular conception tends to restrict the cause to the antecedent, to that which acts, a little reflexion will show us that the cause is only determined as such by its effect, that the two terms are correlative, the one not existing without the other. Finally, with more profound reflexion, the process itself, the transition, the passage, the *nexus* between antecedent and consequent, appears as the vital point, the *proprium quid* of causality. As psychical fact, as state of consciousness, therefore, this notion is complex, and among the elements which compose it, now one and now the other, according to the epoch, has been considered the most important.

In what follows, we shall have to consider: I. the origin of the idea of cause in experience; II. its generalisation, and passage from the individual subjective, to the objective form; III. its transformation as resulting from the work performed in the various sciences, its scission into two fundamental ideas: on the

[1] Lewes, *Problems of Life and Mind*, II. p. 375.

one hand, that of force, energy, active and effective power, cause in the true sense (*vera causa*), which tends more and more to become a postulate, an $x$, a metaphysical residuum; on the other, that of a constant and invariable succession, a fixed *relation*, which becomes the scientific form of the concept of cause, equivalent in all respects to the concept of law.

I. Every one seems agreed, fundamentally at least, upon the empirical origin of the idea of cause. It is of internal, subjective origin; suggested to us by our motor activity. A being who was hypothetically perfectly passive, while seeing or feeling constant external sequences, would have no idea of causality. It would be superfluous to show, by multiplying our quotations, that spiritualists like Maine de Biran, empiricists like Mill, critics like Renouvier, all the schools in short, with varying formulæ, agree upon this point. At the same time it must not be overlooked that some writers attribute an exclusive privilege to the "will," maintaining it to be the type of causality; whereas the assertion that "our own voluntary action is the exclusive source whence this idea is derived" is unjustifiable. If, with some authors, the word "will" is used in a large and vague sense, as designating all mental activity that is translated by movements, no objection can be raised. But if it be used in the proper, restricted sense, as meaning a fully conscious, deliberate act, resulting from motive, the statement cannot be accepted.[1] Volition is a state that makes its appearance somewhat tardily. It is preceded by a period of appetites, of needs, instincts, desires, passions; and all these facts of internal activity, translated into movements, are as apt as the "will" to engender the

[1] For the discussion of this point, see Renouvier, *Logique*, II. 324.

empirical notion of cause, i. e., transitive action, i. e., change produced: they have moreover the advantage of being anterior in chronological order.

Contemporary psychology has studied the rôle of movements, far more than any of its predecessors. It attributes to them a capital importance; it shows that motor elements are included in every intellectual state without exception, in percepts, in images, and even in concepts. Hence it feels no repugnance in accepting the common thesis. We must however remember that the psychology of motion is centred in the consciousness of muscular effort, which moreover represents the type of primitive causality. The nature of this sense of effort has given rise to long and animated debate. For some, it is of central origin: It is anterior to, or at least concomitant with, the movement produced; it goes from within outwards—it is efferent. For others, it is of peripheral origin, posterior to the movement produced; it goes from without, inwards —is afferent. It is an aggregate of the sensations coming from the articulations, tendons, muscles, from the rhythm of respiration, etc.: so that the sense of effort is no more than the consciousness of energy that *has been* expended, of movements that *have been* effectuated: it is a resultant. This second theory, without so far being decisively and incontestably established, is daily gaining more adherents, and remains the most probable. So that, since consciousness of effort is essentially that of *effect* produced, it follows that in considering the act as the source of the idea of cause, we know much less of antecedent than of consequent. Yet this consciousness of effort produced is not the whole, whatever people may say, of what is in the primitive conception of a proper, personal causality.

Something more remains: this is the confused idea, illusory or not, of a *creation* that proceeds from us. We shall return to this point.

To conclude: at the outset, the two terms antecedent and consequent, form almost the exclusive elements in the notion of cause. At any rate, they preponderate in consciousness, to the exclusion of the third, relation. The idea of a constant invariable sequence, which was, later on, to be the intrinsic mark of the causal process, cannot yet be distinguished.

II. The idea of cause—at first strictly individual—soon commences its movement of extension.

1. During the first period, this extension is the work of the imagination, rather than of generalisation properly so called. By an instinctive tendency, well-known, though not explained, man concludes for intentions, a will, and a causality analogous to his own, in the medium that acts and reacts around him: his fellows, all living things, and whatever else by their movements simulate life (clouds, rivers, etc.). This is the period of primitive fetishism that is fixed in mythologies and languages. It may actually be observed in children, in savage races, in brutes (as in the dog that bites the stone by which it is hit), even in rational man, when—becoming again for the moment a creature of instinct—he falls into a passion at the table that has hurt him.

This period corresponds fairly well with that of generic images, because the idea of cause thus generalised results from gross, external, partial, accidental resemblances, which the mind perceives almost passively. It cannot be doubted that the higher brutes have a generic image of causality; i. e., they are capable—given an antecedent—of invariably represent-

ing to themselves the consequence. This mental state, which has been termed "empirical consecution," and which is not infrequent even among men who may never rise beyond it, resolves itself into a permanent association of ideas, the result of repetition and of habit.[1]

All this, however, is merely an external conception of causality, of its form, and not its nature; it is an outside view, an approximation. The proper characteristic of this period is that it remains subjective, anthropomorphic, representing cause as an intentional activity, which produces movements only in view of an end.

2. The second period begins with philosophic reflection, and proceeds by the slow constitution of the sciences. Its development may thus be summarised: little by little it deprives the notion of cause of its subjective, human character, without however completely attaining this ideal end; it reduces the essentials of the concept to a fixed, constant, and invariable *relation* between a determined antecedent and consequent; hence it sees in cause and effect only the two moments, or aspects of one and the same process, which is fundamentally the affirmation of an identity.

Here imagination recedes, to make way for abstraction and generalisation,—for abstraction since it is less a question of terms than of a certain relation

[1] Romanes gives some examples of what he terms appreciation of causality in animals, including that of a setter that was frightened at thunder. "On one occasion a number of apples were being shot out of bags upon the wooden floor of an apple room, the sound in the house as each bag was shot closely resembled that of distant thunder. The setter therefore became terribly alarmed; but when I took him to the apple-room and showed him the real cause of the noise, his dread entirely forsook him, and on again returning to the house he listened to the rumbling with all cheerfulness." Other analogous cases are to be found in his *Mental Evolution in Animals*, Chap. X.

between the terms, for generalisation because the natural tendency of the mind is to extend causality to the whole of experience.

It must, however, be remarked that the transition from particular cases to generalisation, and finally to the universalisation of the concept of cause, *in a strict sense*, has only been effected little by little. An opinion that has gained much credit, on the authority of the *apriorists*, is that every man has an intuitive, innate idea of the law of causality, as universal. This thesis is equivocal. If it means that all change suggests to every normal man who witnesses it an invincible belief in a known or unknown agent of its production, then the assertion is incontestable: but this, as we have seen, is only the popular, practical, and external notion of causality. If the true concept (that of the solidly constituted sciences), which is reducible to an inflexible, invariable determination, is implied, then it is a fallacy to pretend that the human mind acquired it at the outset. The belief in a universal law of causality is no gratuitous gift of nature: it is a conquest. The fallacy persists, because for at least three centuries this idea has been propagated by the writings of philosophers and scientists who have made it familiar enough. None the less, it is a late conception, unknown to the great mass of the human species. Scientific research began by establishing laws, (i. e., invariable relations of cause and effect) between certain groups of phenomena, began by establishing a law of causality that was valid for these and these only; and the transfer of this law to all that is known and unknown has only been effected little by little, and is even yet incomplete. In a word, the law of

universal causality is the generalisation of particular laws, and remains a postulate.

In support of the above (without entering into historical detail) we may note the existence in human consciousness of two ideas, which from time to time, each after its own fashion, give check to the universality of the principle. Although, from the development of scientific thought, their influence has been a decreasing factor, they are still very active. These two ideas are those of miracle and chance.

Miracle, taking this word not in the restricted, religious sense, but in its etymological acceptance (*mirari*), is a rare and unexpected event, produced extrinsically to, or against, the ordinary course of events. The miracle gives no denial to cause, in the popular sense, because it assumes an antecedent: God, an unknown power. It does deny it, in the scientific sense, since it is an abrogation of determinism among phenomena. Miracle is cause without law. Now, for a long period, no belief could have appeared more natural. In the physical world, the appearance of a comet, eclipses, and many other things were regarded as prodigies and warnings. Many races are still imbued with weird fancies on this subject (monsters that would swallow up the sun or moon, etc.), and even among civilised men these phenomena produce in many minds a certain uneasiness. In the biological world, this belief has been much more tenacious: enlightened spirits in the seventeenth century still admitted the *errores* or *lusus naturæ*, held the birth of monstrosities to be a bad augury, and so on. In the psychological world it has been even worse. Not to speak of the widely-spread (and not yet extinct) prejudices of antiquity as to prophetic dreams, auguries of

the future; of the mystery which so long surrounded natural or induced somnambulism, and analogous contemporary speculations on the occult sciences; of those who regard liberty as an absolute beginning, etc.: there is, even in the limited circle of scientific psychology, so little well-determined relation between cause and effect, that the partisans of contingency may comfortably imagine anything. Useless to insist upon sociology. We need only recall the fact that Utopians abound who, while rejecting miracle in the religious order, admit it freely in the social; believing all to be possible, and reconstructing human society from top to bottom according to their dreams. If, finally, we consider that this very dry and incomplete enumeration covers millions of cases, past and present, we must recognise that the human mind in its spontaneous and self-governed progress, experiences no reluctance to admit causes without law.

The idea of chance is more obscure. We might almost say that, for the majority of people who make no attempt to clear it up, it is an event that supposes neither cause nor law; it is sheer indetermination, a cast of the die arriving no one knows how, by means of no one knows what. It is very evident that chance excludes neither cause nor law, but evident to those alone who have reflected upon its nature, and have analysed the notion. To others, it is a mysterious, impenetrable entity, a *Tyche* whose acts cannot be foreseen. Hume says that "chance is only our ignorance of true causes." Cournot rightly observes that this is incorrect, that chance involves something real and positive: the conjunction, the crossing of several sequences of cause and effect, which are independent of one another by origin, and not naturally

intended to exert any reciprocal influence. Thus one series of causes and effects lead a traveller to take a particular train: on the other hand a totally distinct set produces at a given place or time an accident which kills the man.[1] There is, in short, in chance, no contravention of the laws of universal mechanism. Why then does it seem to the vulgar mind to be an exception, indeterminate by nature? First, because the problem set by the unexpected is insufficiently analysed; but also in my opinion, because the primitive idea of cause is nearly always that of a single antecedent, whereas here the unique antecedent is not present, and cannot be discovered. The conception of a complex causation, constituted by a sum of concurrent conditions, of equal necessity, is the fruit of advanced reflexion.

Accordingly, while the man who is formed by scientific discipline refuses when confronted with these so-called prodigious or fortuitous facts, to concede that they are exceptions to the law of universal causality, others are quite ready to admit that the wall that surrounds phenomena may give way at certain points, with resulting breaches.

From the point of view of pure psychology, it is impossible not to affirm that the idea of universal causality, of uniformity in the course of nature, of rigorous determinism (and other analogous formulæ), is acquired—superposed. Whether this notion be applicable to the whole of experience, although experience is not yet exhausted, or whether it is simply a guide to research, a stratagem for introducing order

1 For the study of Chance, see Cournot, *op. cit.*, I., Chap. iii. [Also J. Venn "The Logic of Chance," etc.—*Tr.*]

into things, is a question which psychology has no capacity for discussing, still less power to resolve.

III. We return to the work of transformation, which, starting with the notion of cause as it is given in experience—i. e., a force, a power, that acts and produces—culminates finally in its last term, the law of causality.

Just as the plurality of objects perceived in nature, forms the material of the concept of number; as the diverse durations present in our consciousness are the material of the concept of time; so our consciousness of acting, of modifying our self and our environment (a power which we attribute freely to everything that surrounds us) is the prime material of the concept of cause. But in order that this concept may be constituted as such—fixed and determined—a work of abstraction is needed to isolate and bring into relief its distinctive, essential characteristic from among all the different elements that compose the primitive and complex notion of empirical cause (antecedent, consequent, action or reaction, change, transformation, etc.). This distinctive characteristic is an invariable relation of sequence (the conditions being supposed the same); and the establishment of it has been, almost exclusively, the result of scientific research.

A history of the secular fluctuations in the idea of cause, as affected by the various philosophical theories and changes of method in the sciences, would be the best review of the phases of its evolution. Impossible here to attempt such a task. We may only note the two extreme points: the speculations of antiquity, and the contemporaneous aspect of the question.[1]

[1] Under the title *Zur Entwickelung von Kant's Theorie der Naturcausalität*, (*Philosophische Studien*, IX, 3 and 4), Wundt gives us a rapid historical

The ancient philosophers who (at least during the great eras) were at once metaphysicians and scientists, constructed systems of cosmogony and assumed "first causes," which were conceived either as forces, principles of action, motive elements of nature (water, air, fire, atoms), or as rational types (numbers, ideas). On the other hand they invented mathematics, and laid the foundations of astronomy and physics. Now, as regards causality, these essays at the scientific investigation of nature involved consequences which were not plainly disclosed until a much later period. They exacted another position,—a passage from subjective to objective: whether in relation to the fall of bodies, or to a law of hydrostatics (such as that to which Archimedes gave his name), any one who studies the physical world necessarily sees its changes from without. He considers cause no longer as an internal

sketch. He holds that speculation, in antiquity, is characterised by the method of contraries: the opposition of being and becoming, etc. It is wholly qualitative. The ancients progressed by definition. Elaboration of the concept of mechanical causation was impossible, by reason of the absence of any quantitative determination. This began with Galileo. The progress of mathematics, and the introduction of fractional and irrational numbers made it possible to search out, not merely measure, but also the relation between magnitudes—i. e., *function*. This became the type, and at the same time the goal of all intellectual elaboration, as applied to natural phenomena. This method culminated in the seventeenth century, with the predominance of the logical type. In consequence of the old concept of substance, forces were taken as cause, phenomena as effect. The latter is more frequently derived from cause by deduction, not by intuition. The cause of a determined event might either be the total of its conditions, or one antecedent event. This last conception prevailed, as being the more favorable to the application of mathematics. The eighteenth century marks the genesis of the biological sciences. The growing importance of observation and experimental research made against the preponderance of mathematics. The facts of experience were held more solid than the conclusions of reason. The type of causality is placed no longer in deduction, but in sensory intuition; it is the residuum of experience. This tendency found its exponent in Hume. Kant endeavored to reconcile the two theses; that which models object upon subject (seventeenth century) and that which models subject upon object (eighteenth century).

factor revealed by consciousness, but as a sequence given by the senses. Antecedents, consequents, invariable succession, are for him the only useful data. Conditions equal cause; and the important determination is that not of an operating entity, but of a constant relation. This—the only scientific conception of cause—it is which is covered by Stuart Mill's definition: "Cause is the sum of the positive and negative conditions, which, when given, are followed by an invariable consequent."

This external aspect, old as science itself, was big with consequences that have only been clearly revealed in our own day, and which may be summed up in a word as identity of cause and effect. There is no separation between the two; the antecedent is not one thing and the consequent another; they are two manifestations, different in time, of a fundamental unity. It has rightly been observed that the mechanical theory of the universe (correlation of forces, conservation and transformation of energy, etc.) is the contemporaneous form of the concept of natural causality. Expressed from earliest antiquity in the form of a metaphysical anticipation (*ex nihilo nihil*), it enters in the seventeenth century upon its scientific phase, and is completed in our own day. The physicists who have established it upon experience and by calculation, saw plainly the consequences it involved. To cite only one instance, R. Mayer in his *Mechanik der Wärme* says, "If the cause $c$ produces the effect $e$, then $c=e$; if $e$ is the cause of another effect $f$, then $e=f$, and so on. Since $c$ becomes $e$, $e=f$, etc., we must consider these magnitudes as the different phenomenal forms of one and the same object. Just as the first property of cause is its indestructibility, so

the second property is convertibility, i. e., capacity for assuming different forms. And this capacity must not be regarded as a metamorphosis; each cause is invariable, but the combination of its relations is variable. There is quantitative indestructibility and qualitative convertibility."

It must not be forgotten that the general principles of thermodynamics—the latest form of the concept of natural causality—are not absolute, but are proposed as ideal. We know, *e. g.*, that heat can never give rise again to all the work from which it was produced, that no physical event is exactly reversible, *i. e.* it cannot be reproduced identically at the opposite end of the process, because in its first appearance it had to overcome resistance, and thus lost part of its energy. All this, however, is outside our scope. As much as the doctrine of the conservation of energy is valid, so much is the actual concept of natural causality worth. We merely undertook to follow the evolution of this concept down to the present day, to point out its transformations, without in any way prejudging the future, or still less attributing to it any absolute value.[1]

What now becomes of the idea of causality taken in the other sense, no longer as an invariable relation of antecedent to consequent, but as a thing that acts, creates, modifies, or persists under all transformations

[1] The question is sometimes raised as to whether psychical (and consequently moral, social) facts ought to be included under the formula of conservation of energy and correlation of forces. Since the only evidence produced has been of the nature of theoretical affirmations, or vague and partial experiences, without quantitative determination, the question so far remains open. The concept of natural causality was in the same way considered above in its positive sense, i. e., as a relation of invariable sequence, without inquiring whether it extends to all forms of experience,—or whether it is limited.

and clothes all masks? The scientific method, as soon as it penetrates into any order of phenomena, tends to exclude cause, to reduce it to the strictest limits, to make the least possible use of it. Cause then becomes the synonym of force. But physical science defines force only by its effects:—movement, or work done. So, too, the biologist rejects the notion of "vital force"; non-metaphysical psychology will have none of the "faculties," intervention of "the soul," and the like. Is the notion thus discarded, totally suppressed? Nay,—for even in mechanics and physics it cannot be entirely eliminated. It is there as a postulate, a residuum, an unknown factor covering lacunæ. Yet, do what we will, force or energy, in order to be more than an empty word and to become intelligible, can only be represented and imagined under the form of the muscular effort whence it originates, and which is its type; and despite all the elaborations to which it is submitted in order to rid it of its anthropomorphical character, and dehumanise it, it remains rather a fact of internal experience than a concept. Is it destined to undergo other transformations, by reason of more profound apprehension, or some new aspect of the problem? Is there—along with mechanical causality and rigorous determinism—room for any other mode of causality, proper to psychology, to linguistics, to history, in short to the positive sciences of the mind, as is maintained by Wundt and others? The secret remains for the future.

The natural tendency of the mind (which is but one aspect of the instinct of conservation) to seek and investigate in face of the unknown and unexpected, its clear or confused need of explanation for better or worse, at the outset concluded for an acting entity.

The idea still survives under a naïve or transcendental form; it reappears in every unexplained contingency, whether in regard to the first origin of things, or (for the partisans of liberty) to freedom of action. In this sense, "causality is an altar to the Unknown God, an empty pedestal that awaits its statue."[1]

In its other sense, which is widely different and even contrary, which has been slowly fixed, and more slowly extended to the whole of experience, cause is a true concept: the resultant namely of abstraction, summarised in the characters exclusively proper to it. Under this form it is equivalent to the concept of law.

## SECTION V. CONCEPT OF LAW.

Our general ideas, from those immediately bordering on the concrete to those which attain pure symbolism, constitute a hierarchy of ever-increasing simplicity. What value must be assigned to this thinking by concepts, in proportion as it ascends higher in the scale? We are all familiar with the debates upon this question, bearing, as it does, fundamentally upon the *objective* value of abstraction and generalisation. Psychology, as the science of facts, is able to ignore this point, since it is concerned only with the nature of the two intellectual processes, their variations, and adaptations to multiple cases. Still, it is reasonable enough that it should assume a position, at any rate provisionally, and for convenience of discussion.

To recall only the two extreme opinions: On the one side we have those who maintain that the particular alone exists—for event or individual—that our general ideas are but a means of maintaining order,

[1] W. James, *Psychology*, II., p. 671.

while they teach us nothing as to the nature of things. They are comparable to a catalogue, or to the card-index of a library which are an easy indicator to the millions of books, leaving us totally ignorant as to their contents and value. Hence, the higher we ascend, the farther we penetrate into the region of the fictitious and the vacant.

On the other hand, there are those who assert that nature has general and fixed characteristics; in discovering them, we penetrate into the essence of things. Events and individuals have but a borrowed existence; under their fleeting appearances, we must seek the enduring; and thus, the greater the generalisation, the higher we rise in reality and in dignity.

The psychologist can only take up the position of relativity. To him, general ideas are approximations: they have an objective value, but it is provisional and momentary, dependent on the variability of phenomena and on the state of our knowledge.

On the one hand, the similarities that are the substrata of generalisation are not fictitious. Since, moreover, knowledge of the laws of nature has a practical value, by enabling us to act upon things, and since we fail, in ignorance of them,—we are fain, objections notwithstanding, to attribute to them at least a certain measure of objective value.

On the other, if there is evolution in nature, there must also be evolution in our ideas, and the pretension to laws or types that are fixed unalterably, becomes chimerical. There is no longer the sharp distinction, as formerly admitted, between "essential" and "accidental," i. e., permanent and variable characters. The Primary epoch of our globe may have obeyed laws which no longer hold for our Quaternary

age: all changes in the course of development. We shall return to this point in the concluding section.

Without insisting further upon a debate that is of secondary interest for the psychologist, we may remark that three principal periods can be distinguished in the development of the Concept of Law: viz., the periods of generic images, of concrete or empirical laws, and of theoretical or ideal laws.

It is useless to study the first phase in detail, since it interests us only as an embryonic form, a germ, or essay. It consists in the mechanical conception of regularity for a very restricted number of events. Resulting from the constant or frequent repetition of certain cycles (the course of the sun, moon, seasons, etc.) it is organised in the mind by a process of semi-passive assimilation, that of generic images. Many men have had, and still have, only this shadow, this simulacrum of law, resting upon pure association, upon practical habit, upon the unreflecting expectation of an often-perceived recurrence. Humble as it is, this notion was nevertheless useful in the education of humanity, for it checked the exuberant tendency of the imagination to people the world with capricious causes, obedient to no law. It prevented the establishment of a rule of universal contingency; it was the first affirmation of a faith in regular order. The progress of reflexion, and methodical research, have done the rest.

We owe to Wundt (*Philosophische Studien*, 1886, III., p. 195 et seq.) an observation of great interest to any one concerned in the development of the idea of law. To-day this word is current in all the sciences; indeed its most rigorous acceptance is in mathematics and chemical physics. This was not always the case.

In antiquity, the word was employed almost exclusively in a social, juristic, moral sense. The concept of natural law, regarded as a sort of order, a police-force, was only very slowly formed and established. Copernicus and Kepler employed the word "hypothesis." Galileo calls the fundamental laws of nature "axioms," and those derived from them "theorems," following the terminology of the mathematicians. Descartes begins his Philosophy of Nature by laying down certain *Regulæ sive leges naturales.* Newton says: *Axiomata sive leges motus.* The extension of the word law is due apparently to the need of establishing a clear distinction between the purely abstract axioms of mathematics, and the principles to which we attribute an objective value, an existence in nature. Montesquieu's celebrated definition, "Laws are the necessary relations derived from the nature of things," exhibits this concept in its highest degree of generalisation. We may note, in passing, that in the enquiry referred to above (ch. IV.), nearly all the answers indicate that images of the social juristic order were evoked, although the scientific acceptance of the word was perfectly familiar to a large number of the subjects: showing that the primitive signification preponderates in the vulgar conscience.

In another article, entitled *Wer ist der Gesetzgeber der Naturgesetze?* (*loc. cit.*, pp. 493 et seq.), the same author maintains an opinion, which, notwithstanding its paradoxical appearance, seems to me perfectly valid. Descartes called the laws of nature "rules," inasmuch as they explain phenomena to us; "laws," inasmuch as God constituted them *ab initio* as properties of matter. At a later period, nature takes the place of God, which is still the survival of a panthe-

istic conception of the world. Still later, the preponderating tendency is to call laws by the names of their inventors: Mariotte, Gay-Lussac, Dulong and Petit, Avogadro, Ohm, Weber, etc. "In the seventeenth century it was God who established the laws of nature; in the eighteenth it was Nature herself; in the nineteenth it is the affair of the scientists." This thesis agrees with what was said above of the approximate character of laws, of the mixture of objective and subjective elements that obtain in their formulæ, and it is no paradox to assert that the state of mind of a Mariotte, a Gay-Lussac, a Weber, etc., when they discover their law, represents this approximation at a given moment.

I. Empirical laws correspond, broadly speaking, with the intermediate forms of abstraction and of generalisation. They consist in the reduction of a large number of facts to a single formula, but without any rational explanation. In the course of events we discover a constant relation of co-existence or of succession between two or several facts; we mentally detach this regular relation from the total which includes it, and extend it to other cases. Constancy is not even necessary for empirical laws, frequency suffices: at least one often has to be content with it. These laws abound in the half-sciences, and in embryo science: they are useful, they give order and simplification.

Their first characteristic is that they are identical with fact. Laws and facts are only two aspects of the same thing. To pass from facts to their empirical law, is merely replacing simple and homogeneous cognition by abstraction, multiple and heterogeneous cognition by perception. Hence the empirical law is

rightly compared to a general fact, and it is legitimate in psychology to say the law of association or the general fact of association. On the other hand (in virtue of the natural tendency to anthropomorphism) vulgarisms such as "laws govern facts," and the like, encourage in many minds the illusion of an ideal world of law superposed upon the world of facts, external to experience, and acting upon it like a government.

A second characteristic, which though frequent is not universal, is complexity. Necessarily objective, since it is a simple notation of observed facts, the empirical law does not always succeed in embracing the results of abstraction in one short and simple formula. Sometimes it does so; sometimes it is confronted with a multiplicity that cannot be reduced to a single proportion; in many cases it has to distribute itself, and resignedly to employ a long formula. Ex.: in physiology, Pflüger's law (or the laws of reflexes), in linguistics, the laws of Grimm, etc. Here there is a summary description, reduced to the principal facts. It often has to cover a great number of details, as in Listing's law (of the rotation of the ocular globe). Plenty of examples are to be found in the sciences that are in process of formation, and ill-constituted: psychology,[1] ethics, sociology, etc. Empirical law

[1] Sigwart in his *Logik*, Book II. (English translation by Helen Dendy) has made a profound study of the classification of the psychological laws in psychology, and their relative value. He divides them into three categories, according to the nature of the relations which they express: 1. Psychophysical laws which formulate constant relations between states of consciousness and the cerebral states. Ex. the relation between the sensation directly received, and the image that is reproduced in consciousness. 2. Psychological laws properly so-called; these express the internal relations of the states of consciousness. Ex. Law of conservation of impressions, law of association, law of systematisation by volition. 3. Laws expressive of the reciprocal action that human thoughts and volitions exert one upon the other: they pre-

could only be further simplified by changing its nature, namely by transforming it into theoretical law.

Empirical law is thus the type of law that is immanent, contained in the facts, invoking their representation directly and indirectly by means of intermediate abstraction, involving ascending degrees of abstraction, that, at their highest level, bring it insensibly very near to ideal law.

II. Theoretical, or ideal, law corresponds with the higher forms of abstraction. It exhibits increasingly approximative constructions of the mind, in proportion as these ascend, and are farther removed from experience. Empirical laws are the material whence they are derived, and the transformation is accomplished at the moment, and in the degree, in which description gives place to explanation. To minds accustomed to the discipline of the strict sciences, this conception of law alone is valid, and they are prone to treat with disdain or defiance the formulæ that are a simple summing-up of the results of experience, judging them unworthy of the name of laws. To the psychologist, the position is quite other: empirical concept and theoretical concept are two forms, two aspects of the same intellectual process: there is no constitutional difference between them. Nevertheless, in its higher form, the concept of law has its proper and special characteristics which must be noted.

1. Simplicity, as contrasted with the complexity of empirical laws; this is the necessary corollary of the operation that gives rise to it, since it is an abstraction of abstractions, the final result of a long se-

suppose the intervention of social causes, and are to this day vague and ill-determined; hence there are no fixed rules for the government of humanity, or the bringing up of children.

ries of eliminations. Compare with the long, vague, entangled formulæ, charged with details, of which examples were given above, the enunciation of the higher laws, which are usually short and invariably precise. And, it may be added, invariably lucid, at least to the scientist who is in the habit of dealing with them, because he knows exactly what they cover. In this connexion a saying of D'Alembert deserves to be recalled and considered, because it discloses, better than any commentary, the psychology of abstract minds: "The most abstract notions, such as the majority of mankind regard as the most inaccessible, are often those which carry with them the greatest elucidating power: our ideas seem to be blotted out by obscurity in proportion as, in any object, we examine into its sensible properties."

2. Quantitative determination. The higher laws alone can assume a numerical form, and it is a truism to say that the perfection of any science is measured by the quantity of mathematics which it involves. Not that mathematical formulæ imply or confer any magical virtue, but they are the sign of reduction to clear and simple relations, and are frequently an instrument of further progress. It is true that in the domain of empirical law, there are many processes which attempt to imitate quantitative determination: graphic records, curves, statistics, percentages, etc. Yet these are often a very poor substitute for the equation, or worse—for they offer an illusory preciseness, and are fallacious.

3. It is well to insist upon the ideal character of these laws, because one is apt to forget that, in virtue of their very abstraction, they can be approximate only; and can but be applied, and reduced from theory

to practice, by means of rectifications and additions. It has been said that "physical laws are general truths that are invariably more or less falsified for each particular case." All scientific men, and there are many, who have reflected on the subject, bring out this character of approximation.[1]

Thus—it is not absolutely true that a movement is uniform and rectilinear. The theoretic law of the oscillation of a pendulum is unrealisable, because there is no non-resisting medium, no totally rigid and inextensible bar, no suspending apparatus capable of turning without friction. A planet could only describe an exact ellipse if it alone were turning round the sun: but as, in point of fact, there are several which act and react upon one another, Kepler's law remains ideal. It is known by very accurate researches that Mariotte's law of the relations between the density of a gas, and the pressure which it bears, is not strictly accurate for either; but the differences between theory and reality are so slight that, in ordinary cases, they are negligible. The laws of thermodynamics (conservation of energy, correlation of forces) which are so much used in the present day because of their character of generality, and are held by some to be the ultimate principle of phenomena, have no absolute value. It is not, e. g., correct to say that all change generates a change which can be re-trans-

1 "Fundamental laws are, or should be, only the simplest, most abridged, and most economical mode of expressing facts, within the limits of precision possible to our observations and experiences. The laws of nature are simple, essentially because—among all the possible modes of expression—we choose the simplest" (see Mach, *Mechanics*. Chicago, 1893, and *Popular Scientific Lectures*, 23d ed., Chicago, 1898, under the headings "Economy of Thought," "Law," etc.). "In formulating a general, simple, precise law, based upon relatively few experiences, which, moreover, present certain divergencies, we only obey a necessity from which the human mind cannot free itself." (Poincaré.)

formed without loss or addition. The first moment of enthusiasm passed, there was no lack of criticism and of reservation on this point. And so in other instances, *ad infinitum*.

In brief, the concept of law, whenever it is more than a vague term in the mind, corresponds either to a direct condensation of facts (empirical laws), or to an ideal simplification (theoretical laws); but, imperfect or perfect, the mental process is the same in the two cases. They differ only in the degree of simplification attainable by analysis for any given material or datum. If empirical law, which is in strict relation with experience, has not been idolised, this distinction and misfortune has frequently befallen the other categories. It has been forgotten that, in the sciences as in the arts, the ideal is only an ideal, although it is here attained by different means, viz., elimination, voluntary omission for the sake of preciseness, a more or less artificial reduction to unity. Consequently many have fallen into the strange illusion of believing that, in manipulating experience by the labor of an ever-growing abstraction, the absolute can be brought out.[1]

## SECTION VI. CONCEPT OF SPECIES.

In departing from phenomena by successive abstractions and generalisations, we rise to laws that are more and more extensive: so in setting out from the individual, species, genera, orders, branches, and the

[1] Since our subject is the tracing out of the *concept* of law in its different degrees, starting from the generic image, we have no need to study the nature of the laws proper to each science (logic, mathematics, mechanics, physico-chemistry, biology, etc.), nor to discuss their value. For this point, see Boutroux, *L'Idée de loi naturelle dans la science et la philosophie contemporaine*. Paris, 1895.

like, are formed by a succession of abstractions and generalisations. We have already followed this labor of the intellect in its primitive attempts to introduce order into the multiplicity and variety of living beings (Ch. III.). We saw its start in the period of generic images, its passage through the various degrees of the concrete-abstract period, and its final outcome by diverse paths into a unitary conception. We must now take up the subject from the point at which we left it, and consider the nature of the classificatory concepts at the final term of their development, the moment of their highest scientific determination. If the geometers were the first who abstracted from extension the essential data of Space; if the astronomers accomplished an analogous operation for Time; the naturalists for their part had by abstraction to disengage from among the numerous characteristics of living beings, those which, as fundamental, enable them to reduce individuals to species, species to genera, and so on. They are the inventors of the concepts which govern this province of experience.

The notion of the individual, which is the basis, and preliminary material, of biological classification, is sufficiently clear so long as we confine ourselves to the higher creatures; it becomes obscure and equivocal in descending to the lower grades, where life multiplies by budding, or by division. Hence it has been a great stumbling-block to the naturalists. For our purpose, the point is negligible. We can without inconvenience omit the debates on this subject, and presume that individuality always has its fixed characteristics. The work of abstraction and of generalisation alone concern us.

Among all others, the Concept of Species is cer-

tainly the one which—more especially in our own day —has been the most studied and disputed. Many efforts have been made to determine its essential characters, to which some attribute, and others refuse, an objective value. In effect, and broadly speaking—two contrary theories obtain in this connexion:

1. That of fixity of species, the oldest, and long paramount: still perhaps finding its partisans. If we accept this, we admit at the same time that the naturalist in determining species, reveals a mystery of nature, and partially discovers the plan of creation.

2. The complete antithesis of the foregoing, which maintains that only individuals exist. In its absolute and radical form, this assertion seems rarely to have been brought forward. It has, however, been said that "the idea of species is not given to us by nature itself."[1] In point of fact, the contention of the transformists is different. They do not refuse to recognise the grouping of living beings, according to their degrees of similarity, into varieties and species; but they grant to species only a momentary fixedness in time and space. It does not exist, it is not a natural type, it is transitionally a stable variation; the individual is the reality. From our point of view, this signifies that the specific characters isolated by abstraction are of value only as practical means of simplification in no way helping us to penetrate into the nature of things.

However this may be,—and without for the mo-

[1] Brown, quoted by Quatrefages (*Précurseurs de Darwin*, p. 218), who adds, "If this were the case, one would not find many species denoted by particular names among savages, and our own illiterate population. The general notion of species is on the contrary one of those that are forced upon us, directly we look round. The difficulty is to formulate it clearly, to give it scientific precision, and this is a very real problem."

ment inquiring whether the work of abstraction in this province gives objective or subjective results, whether it limits itself to simplification in relation to man, or discovers in relation to nature,—let us follow it in its ascending progress. Once again, we can distinguish two principal stages: that of species corresponding to empirical and concrete law; that of genera, and the still higher forms, corresponding to theoretical and ideal laws.

I.

The nature of a concept is fixed by the determination of its *constituent elements;* these are determined by abstraction. Abstraction that is not vulgar and arbitrary, but scientific, should disclose characteristics that are the substitutes for a group (here living beings in general), taking its place, and enabling us to think it. These constituent elements of the concept of species are met with in nearly all the naturalists' definitions.[1] They are two in number; species is determined by two essential characteristics: similarity (morphological criterion), filiation (physiological criterion).

1. Similarity seems at first sight easy to determine —as though we had only to open our eyes; yet by this elementary procedure we hardly pass beyond the level of generic images, and there is risk of falling into many errors. It is necessary to penetrate into resem-

[1] Quatrefages (*op. cit.*, pp. 219–222) gives a great number of definitions of species. A few may be quoted: "Species should be defined as a succession of wholly similar individuals, perpetuated by means of generation" (De Jussieu).—"Species is a constant succession of like individuals, which reproduce themselves" (Buffon).—"By species we mean any collection of similar individuals, that have been produced by individuals like unto themselves" (Lamarck).—"Species is the individual repeated and continued in time and space" (Blainville).—"Species is the totality of all individuals that have the same origin, and of those that are as like them, as they are among themselves" (Brown), etc., etc.

blances deeper than the superficial; and here is the first degree of complexity. Buffon observed that "the horse and the donkey, which are distinct species, resemble each other more than the water spaniel and the harrier, which are of the same species." The facts which our contemporaries denote by the name of *polymorphism*, entirely baffle the criterion of similarity. Not to speak of the obvious difference between the larva and the perfect insect, the caterpillar and the butterfly, or between the males, females, and neuters of bees, ants, and termites; there are cases in which the disparity between the two sexes is so great that the male and the female, taken respectively as two different creatures, have been classified in distinct *genera*, and even *orders:* e. g., the lampyris or glow-worm, *Lernea*, and many others. The character of the resemblance is thus too often vague, sometimes deceptive, nearly always inadequate: it follows that we must resort to the other, to filiation.

2. This, the physiological criterion, again appears to leave no opening for equivocation, since it can be materially stated. Generally speaking, one is imbued with the notion that children resemble their parents, that the immediate product is the reproduction of the type of the progenitors. But the alternating generations (metagenesis, geneagenesis) discovered in the course of the present century, show that this conception is too simple, and often fallacious. This mode of reproduction is by no means rare; we meet with it among a great number of the lower plants, infusoria, worms, and even insects. "The dominating fact in the reproduction of all these creatures, is that a *sexual* being, of definite form, gives birth to *a-sexual* beings which do not resemble it, but which in their turn pro-

duce by a sort of budding, or by fission of their bodies, the sexual creatures similar to those from which they issued." Vogt, accordingly, in his definition of species, is forced to include the case of alternate generation by saying: "Species is the reunion of all the individuals that originate from the same parents, and are in themselves, *or in their descendants*, similar to their primordial ancestors."

In brief, the general notion of species depends upon two ideas, complex notwithstanding their apparent simplicity, fluctuating in spite of their apparent precision.

Till now, we have spoken of species as if it were directly superposed upon individuals, as if it resulted from immediate generalisation. This is not the naturalists' position. Their classification descends from the species to the individual by decreasing generalisations of the race and the variation. Thus the human species comprises several races (white, yellow, etc.), the white race comprises several variations (English, Arab type, etc.). To the partisan of fixedness of species, these three general notions have not the same value: species alone has peculiar and irreducible characters, which are deduced from the function of reproduction and the facts of cross-breeding.

Couple two individuals of distinct *species:* the union is generally sterile. If otherwise, the hybrids which result from it are unfruitful. If, as rarely happens, they propagate themselves, the offspring rapidly return to the type of one of the ancestral species.

Couple two individuals of distinct *races* or *variations*, the union will be fruitful; the resulting cross-breeds are again fertile; the progenitors are able to create and fix varieties, and even races.

Hence, it is concluded, species must be a thing that exists, that protects itself, does not let itself be encroached upon.

Evidently the debated question is one of facts: and both the parties in dispute adduce experimental evidence. Few in number as they may be, there are fertile hybrids, which perpetuate themselves. They are found among birds and mammals, e. g., the alpaca and the vicuna, the bull and the zebu, the goat and the sheep—which have for issue the ovicaprinæ,—the hare and the rabbit—whose offspring is the leporide, (their perpetuity has been contested). On the other hand, if certain *species* have thus been formed by a durable blend, there exist *races* that have been refractory to all attempts at cross-breeding: i. e., the domestic and Brazilian guinea-pig, different races of rats, of rabbits, etc.

We need not enter into the discussion, nor enumerate the observations and experiments invoked on either side: they are to be found in special works. Our aim was to discover the constituent elements of the notion of species in its scientific aspect. Now, neither the morphological element nor the physiological element has any distinguishing mark of permanence and universality. The concept of species is possessed of no absolute value; neither is it a simple replica in the mind of the "plan of nature." The result of abstraction and of generalisation, it corresponds to something which is fixed for a certain time in certain conditions; it has temporary and provisional objectivity.[1]

[1] For the transformists, as is well known, variety, race, and species are not fixed concepts. "From variety to race, from race to species, there is a continuous insensible passage. Individual modifications, at first slight, give rise to a variety or to a race. Continuing to augment, and extending to a con-

II.

Contemporary discussion is almost entirely centred upon species. Little is said about genera, and still less of the higher divisions. We do not, in any case, find what we require: the determination of constitutive elements, of general acceptance, which shall be for the genus, family, order, or class, the equivalent of the two denotative marks—morphological and physiological—that are attributed to species.

This has not always been the case. At the time when there was general belief in a scheme of creation, the naturalists were careful, by bringing together species, genera, families, etc., to disengage more and more general characters, which they regarded as essential, and determined by the nature of the thing. We have already said that Linnæus was the first to formulate a precise notion of genus, to which he expressly attributed a *reality:* "You must know," he says, in his *Philosophia botanica*, "that it is not character that constitutes the genus, but genus the character; that character devolves from genus, not genus from character; that character exists not in order that genus should come about (*fiat*), but so that the genus should be known." In the binary nomenclature which he adopted, the first term designates the genus, the second one of the species included. Thus the dog and the wolf have characters by which they resemble each other, and are distinguished from other animals (five fingers on the anterior limbs, four only on the posterior, twenty-two teeth in the upper and lower jaw, etc.) Linnæus classifies them as the genus *Canis*,

stantly increasing number of individuals, they may come to constitute specific characters. Pursuing its evolution, the species then finally reaches the rank of the genus, family, etc."

of which *Canis familiaris*, *Canis lupus*, *Canis vulpes*, etc., are the species. Again, the genus *Felis*, determined by the characters common to certain animals exclusively, comprises in its species: the cat (*Felis catus*), the lion (*Felis leo*), the tiger (*Felis tigris*), etc.

Agassiz, the last representative of the line of naturalists who aspired at reproducing the order of nature in the hierarchy of their classificatory concepts, characterises the genera and divisions superior to them by vague formulæ. Of these we can judge from the following passage:

"Individuals are the support, at the actual moment, of the characters not merely of species, but of all other divisions. As representative of *genus*, they have certain details of a definite and specific structure, identical with those possessed by the representatives of other species. As representative of *family*, they have a definite constitution, expressive of a distinct and specific model, in forms resembling those of the representatives of other genera. As representative of *order*, they take definite rank, as compared with the representatives of other families. As representative of *class*, they manifest the structural plan of their ramifications by the aid of special means, and according to specific directions. As representative of *branches* the individuals are all organised on a distinct plan which differs from the plan of other branch-lines."[1]

It was shown above (Ch. III.) that the contemporary classifications, which are radically embryological, transformist, and generic, proceed otherwise, and have a different aim. Their ideal is to draw up the genealogical tree of living beings, with its multiple ramifications, marking the principal moments of evolution.

[1] *De l'Espèce*, Ch. II., §§ 6 and 7.

But if, leaving aside the material of these (animal or vegetable) classifications, we consider only the psychological labor by which they are constituted, we find that the transformists and their adversaries have at least one common point which is of cardinal importance. The notion of fundamental types—conceived as fixed or provisory—is for the one as for the other a compass, a guide in research, a normal, by means of which deviations are appreciated. Hence, these concepts have a practical value, and it is true that we find abstraction and generalisation in their principal rôle, which is, not to discover, but to simplify, above all to be useful.

In effect, the one side, yielding to the natural tendency of the mind to reify abstractions, admit the permanence and objectivity of types: they believe firmly that they have in certain concepts the possibility of an ideal reconstruction of the entire world of living beings. This faith sustains them and urges them on to more and more exact determinations.

Their opponents, the transformists of every degree, are guided by a different ideal; they search after continuity, transition, forms of passage. Species, genera, families, etc., are but provisory starting-points, with intermediate lacunæ which they endeavor to bridge over. Although the animal order, the chain of life, is itself only a theoretical construction, a natural abstraction, many fine works could be quoted which are inspired by this faith in continuity. Such, e. g., are Huxley, Cope, and others upon the genus *Equus*, establishing the filiation of the four-fingered *Eohippus* of the old Tertiary epoch, with the Hipparion of the new Tertiary epoch, and with the Horse of the Quaternary period.

The hierarchy of concepts formed by superposition of abstractions and generalisations only facilitates the task. The sole incontestable value that can be assigned to any notion of species, and still more to genus, and other still more general concepts, is that of utility. They are successful implements in the investigation of nature. All other pretensions are open to discussion. One position more especially is untenable: that which claims for concepts, the pure results of abstraction, an absolute value. It is obvious that they can have none. They are neither reality nor fiction, but approximations.

* * *

Laws and species—two general notions which must be connected—were bound to vary in the course of evolution, because they are entirely subordinated to the conditions which govern the existence of phenomena and of living beings. Let us—merely as an illustration to fix our ideas—admit the hypothesis of a primitive nebula. Imagine (which is impossible) an intelligent being, able, at that point in the world's history, to draw up a scheme of the existing laws. He could discover none but those which govern matter in the gaseous state,—some of which are still extant, others unknown to us, and unknowable—since, their conditions of existence having ceased, they are annihilated. When at a later time this matter, uniformly diffused and dispersed through space, became divided from one or other cause into vast nebulous spheres commencing their slow revolution, our hypothetical being might have surprised the birth of the astronomical laws. Subsequently, the constitution of the liquid state of matter, and then of the solid state in its different degrees, would give birth to new physico-chem-

ical laws, others meantime disappearing. When, finally, life—whatever may have been its origin—appeared, other laws again loomed forth, and the possibility of classification. Yet to the hypothetical spectator, these must needs be highly singular, highly dissimilar from our own—unless we admit the hypothesis of a world created at one throw.

It is needless to enter into the details of this long evolution, as it is generally admitted to have been. Enough to remember that the matter whence abstraction deduces laws and species has varied, and may vary again in the course of ages. If, on the other hand, we consider the slow progress of human knowledge, and the incessant corrections imposed by experience and reasoning from century to century, we find ourselves confronted with two variable factors, one objective, the other subjective. No permanence can result from their union. Long as may be the stability of laws and species, nothing guarantees their perpetual duration. So that after two centuries which make a brave show in the history of the sciences, we may still advance the formula of Leibnitz: "Our determinations of physical species are provisional and proportional to our knowledge."[1]

Many other concepts might be added to the preceding, among them, those of the moral sciences. I forbear, because the history of their fluctuations would in itself exact a volume. Till now, these have been ill-determined, badly defined. May we even speak of any regular evolution? Have they not rather suffered *corsi e ricorsi*, which bring them back perennially to their point of departure? Whenever—during a development of centuries—the work of abstraction has suc-

[1] *Nouveaux Essais*, III., § 6, 23.

ceeded, we have seen it pass through successive phases :—generic ideas, intermediate forms, higher forms—but not by any constant process. Sometimes it has rapidly attained the period of complete simplification, as in mathematics; sometimes it is long arrested in its progress, as in the natural sciences: sometimes, again, as in the less established sciences, it is incapable even to the present day of transcending the lowest stages.

# CHAPTER VI.

## CONCLUSION.

WE have endeavored to show how the faculty of abstracting and of generalising has been developed empirically, and to follow it in its spontaneous and natural evolution as shown in history,—not in the philosophical speculations which are only its efflorescence, and which, for the most part, ignore or despise its origins. It remains to us, in conclusion, to seek out how, and by what causes, this intellectual process has constituted and developed itself: further —what are the different directions it has followed in the course of its development.

I. To contemporary psychology, the mind is a sum of processes of dissimilar nature, whose mode of appearance and of evolution depends upon predetermined conditions. In the total of intellectual operations, abstraction is a process of secondary formation: it does not belong to the primary stratum of sensations and percepts, of appetites and tendencies, of primitive emotions. We found however that it was there in embryo. How then, instead of remaining in this rudimentary state, has it been so differentiated as to become a function proper to the intellect, and with a long development that is still in progress?

The primary condition is the existence of *attention*, which brings a few points into relief, amid the general confusion. We have shown elsewhere that attention itself depends originally upon the instinct of individual preservation.[1] Attention, however, can only precede and prepare for abstraction, because it is a momentary state of application to the variable aspects of events, and does not isolate anything.

We know how the first labor of separation, of dissociation, takes effect in the formation of generic images, and how the extracted quality *fixed* itself, for better or worse, by the aid of a visual, auditory, tactile scheme, by a movement, a gesture, which confers on it a sort of independence.

Finally, with the word—the substitute for the abstract intuition—the mental dissociation approximates to a real dissociation: the abstract character, incarnated in the word, seems, as happens only too often, to exist by itself. The process of abstraction, with its fitting instrument, is completely constituted.

During these successive phases, and afterwards, throughout the course of the historical development of human intelligence, the progress of abstraction and of generalisation, depends upon two principal causes: one general, i. e., utility; the other accidental and sporadic, the advent of inventors.

1. In his book on *Darwinism* (Ch. XV.) Wallace, in contesting the theory that applies the law of conservation of variations, useful in the struggle for existence, to the mental faculties, insists at length upon the mathematical faculty; he maintains that it is an inexplicable exception, a case that cannot be reduced to law. The inaptitude of inferior races for even the

1 *Psychology of Attention*, Ch. I. (Chicago: Open Court Publishing Co.)

simplest calculations is well known ; how—from such a rudimentary origin—could it develop into the genius of a Newton, a Laplace, or a Gauss? What motive power accounts for this development? The author establishes by a host of sufficiently useless historical details, that mathematical superiority played no part in the struggle of tribe with tribe, and later on of people with people (Greeks against Persians), and that the victory resulted from other causes, moral and social. For this there is abundant evidence. But since mathematical aptitude is only a particular instance of abstraction, albeit one of the most perfect, the question ought to be proposed under a more general form. Had the aptitude for abstraction, *ab initio*, any practical value? Yes, "the motive power that caused its development, that Wallace claims without specifying it, is utility."

To avoid possibility of equivocation, let us remark that the development of the attitude for abstracting and generalising may be explained in a two-fold manner: by acknowledging the influence of heredity, and by omitting it.

In the former case, it is supposed that this aptitude appears as a "spontaneous variation" in the individual or race, that it fixes itself, is reciprocal, grows by slow accumulation in the course of generations. This theory postulates the heredity of acquired characters, which is accepted by some, rejected by others, more especially since the advent of Weismann. I refrain from invoking it, by reason of its hypothetical and disputed nature. The probability of any transmission would moreover be far harder to establish here than in other psychical directions, such as imagination, or feeling.

In the second case, with elimination of the hereditary factor, progress must be attributed to social causes, utility and imitation. From all time there have been minds which when face to face with practical problems knew better than others how to extract the essential, and neglect the accessory, in the complex of facts. The utility of abstraction is identical with that of attention, which does not require demonstration; it may be summed up in a single word: to simplify. As the process succeeds, it finds imitators. There is no need to admit at the outset any reflected and fully conscious abstraction: a happy instinct, guided by the needs of life, is sufficient at the commencement. Races that are poorly gifted in this respect, or little apt at imitating their betters, have never got beyond a low level. In effect, abstraction and generalisation are the nerve of all knowledge that transcends sensation. Is this mode of cognition useful? There can be no possible doubt as to the answer.

2. The rôle of inventors corresponds to the fact which, in transformist terminology, is known as spontaneous variation. By inventors, we mean those who are born with the talent or the genius for abstraction. It is superfluous to prove that such have been found, in considerable numbers. They are abstract thinkers by instinct, as others are musicians, mechanicians, designers. The biography of the great mathematicians abounds in examples: Pascal inventing geometry out of a few vague indications from his father; Newton divining Euclid's demonstrations from the simple enunciation of the theorems; Ampère, before he could read or understand the use of figures, making long calculations by means of a few pebbles;

Gauss, at five years old, rectifying the arithmetic of a workman, etc. If fewer analogous facts can be quoted from the other sciences, it is because mathematical precocity is frequent, and is more surprising. All that is the effect of innate disposition: this word serving only to recapitulate our ignorance of the causes which produce such minds. In the development of knowledge by abstraction and generalisation, the first cause —utility—may be likened to the part played by slow actions in geology; whether in the case of practical inventions, or of the constitution of an idiom, it is continuous, collective, and anonymous. The rôle of the great abstract thinkers, on the contrary, resembles the rapid and epoch-making actions.

II. If we now consider the progress of abstraction from a more general point of view (instead of following it step by step, from its lowest to its highest degree, as in the preceding chapters), i. e., according to its orientation towards a given end, we find that it has followed three principal directions during its history: practical, speculative, scientific. These are, indeed, inseparable, inasmuch as practical abstraction leads to science, scientific abstraction is profitable to practice, and speculation cannot entirely forego the other two.[1]

Abstraction and practical generalisation are necessarily the first in order, as we found in studying their first appearance in the lower animals, in children, and in savages. They serve to distinguish the qualities of things by some word, or sign; they subserve the simple adaptations of daily life. Later on, at a higher stage, they note the appearance of mixed processes,

[1] For a study of the function and practical value of symbolism consult Ferrero, *Les lois psychologiques du symbolisme;* Paris, F. Alcan.

which, while more especially directed to utility, are already the prelude to scientific knowledge. Disinterested curiosity has awakened, and timidly makes for daylight. A minimum acquaintance with the history of the sciences teaches us that all were at their origin processes of *applied* research, and that often, in their uncertain efforts, our forbears found what they were not looking for. The numerative systems issued from the need of counting objects, and later on, from rude commercial exchanges. Elementary geometry was required, in order to measure the fields, to determine a right angle, to fix relative positions, and to furnish the indispensable parts of primitive architecture. The invention of the lever, of the balance, of rudimentary engines for the lifting of heavy masses, gave the first foundations of mechanics. Astronomy arose in the desire to regulate civil life and the religious festivals, and the wish (e. g., among the Peruvians and Mexicans) not to irritate the gods by delaying the sacrifices due to them. Metallurgy, and later on the search for the philosopher's stone, and the elixir of life, were the prelude to scientific chemistry. The historical outset of each science would furnish a profusion of similar facts.

The two other operations issued by an internal division of labor from this—at first the only—tendency of the mind.

First come purely speculative, i. e., philosophical or metaphysical abstraction and generalisation. This new trend has clean and well defined characteristics; and it was, in antiquity, the privilege of two peoples alone, the Greeks and the Hindus. Abstraction leads immediately to the highest generalisations; from the crude and direct simplification of a few facts, the

mind leaps at a bound to the final causes of things; it skips the intermediate stages: it ignores the sequence of slow and progressive evolution. This procedure where, in point of fact, abstraction and generalisation are only the servants of a particular form of imagination, found its first complete expression in Plato, and the Theory of Ideas. With Plato, the human intellect tasted for the first time the supreme pleasures of playing with the highest abstractions, and believing firmly that the universe can be summed up, constructed and explained by the help of some few entities. In this direction, notwithstanding its manifold changes of aspect, the generalising process has remained fundamentally the same, and has done no more than repeat itself. We are here concerned with statement, not with criticism. Psychologists must needs admit that this tendency to construct the world (whether or no it be illusory) is a fact inherent in the nature of the human intellect. Stallo, in the book already quoted,[1] gives an incisive critique of the fundamental concepts of the physical sciences, and their unconscious trend towards metaphysics. His appreciation of the characteristics proper to the purely speculative process of abstraction and generalisation is so apt, that we cannot do better than transcribe it:

"Whatever diversity may exist between metaphysical systems, they are all founded upon the express or implied supposition that there is a fixed correspondence between concepts and their filiations on the one hand and things and their mode of interdependence on the other. This fundamental error is in great part due to a delusory view of the function of language as an aid to the formation and fixation of concepts. Roughly stated, concepts are the meanings of words; and the circumstances that words primarily designate things, or at least objects of sensation and their sensible

1 *The Concepts and Theories of Modern Physics*, Ch. IX., p. 137, 3rd ed.

interactions, has given rise to certain fallacious assumptions which, unlike the ordinary infractions of the laws of logic, are in a sense natural outgrowths of the evolution of thought (not without analogy to the organic diseases incident to bodily life) and may be termed structural fallacies of the intellect. These assumptions are:

"1. That every concept is the counterpart of a distinct objective reality, and that hence there are as many things, or natural classes of things, as there are concepts or notions.

"2. That the more general or extensive concepts and the realities corresponding to them pre-exist to the less general, more comprehensive, concepts and their corresponding realities; and that the latter concepts and realities are derived from the former, either by a successive addition of attributes or properties, or by a process of evolution, the attributes or properties of the former being taken as implications of those of the latter.

"3. That the order of the genesis of concepts is identical with the order of the genesis of things.

"4. That things exist independently of and antecedently to their relations; that all relations are between absolute terms; and that therefore whatever reality belongs to the properties of things is distinct from that of the things themselves."

The differences between this procedure and that proper to the third (or scientific) direction need hardly be enumerated.

Here the advance is step by step, without for an instant losing hold of the thread that leads back to the starting-point of experience. Even where the mind takes giant strides, or leaps across the intermediate generalisations, it pauses to verify its results and to take up the thread it had loosed for the moment. This is the typical process. Since it formed the basis of our discussion of the intermediate and higher forms of abstraction, we need not here return to it. Yet in conclusion, it is well to recall once more what makes it of sterling value.

To reduce the essentials of abstraction and gener-

alisation to the exclusive use of the word (or sign) as is customary, is an error that can only be explained by the time-honored neglect of the function of the *unconscious* in psychology. The sign is no more than an instrument of simplification, an abbreviated formula. When the mind works with the aid of concepts, the co-operation of two factors, the one conscious, the other unconscious or sub-conscious, is required, in order that its labor may be legitimate and fruitful: on the one hand, we have words or signs, accompanied sometimes by a vague representation; on the other hand, a latent, potential, organised knowledge. We endeavored above (Ch. IV.) to show how this *couple* forms and fixes itself. The mechanism is invariably the same, without exception. Whether we keep up a trivial conversation by means of the abstract terms which compose our languages, or whether we ascend to the highest generalisations, there is in the mental state no more than a difference in degree; there is no difference in nature. Beneath the words that are the clear factors, exists the dumb travail, the vague invocation, of the organised experience that gives life to them. Without this unconscious factor which may, often does, become conscious, there is nought but illusion. When we induct, deduct, traverse a long series of abstractions to demonstrate or to discover, the useful work consists in new relations which establish themselves in our organised potential knowledge; words are no more than the instruments that commence the task, facilitate and mark its phases. When the mind is grappling with the highest abstractions, and climbs from height to height, what preserves it from catastrophe, and guarantees against error, is the quantity and quality of the unconscious material stored

up beneath the words. The entomologist who at first sight, and immediately, classifies one insect among millions of species, acts in virtue of his long experience, impressed firmly in his memory with salient characteristics: he proceeds from the sensory data to the name. In the inverse operation, when he merely enunciates the name, all this acquired knowledge is the substrate. The existence of these conscious-unconscious couples is, so to speak, a rule in pyschology: general ideas are but a particular case, perhaps the least well-known: hence we previously likened them (Ch. IV.) to *mental habits*.

It follows that in proportion as we ascend in generalisation we rise, not into vacuity, as has been said, but into the simple—as also, it must be confessed, into the approximate. The relatively empty concepts (there are none that are absolutely void of content) are the product of a discontinuous generalisation which prevents descent without interruption or omission into the concrete. Of course these are chiefly encountered in the world of pure speculation. They are names representing a knowledge that is incomplete, partial, inadequate, or ill-organised; they correspond not to elimination of what is useless, but to deficit of what is necessary. Having no possible contact with reality, they float in an unreal atmosphere, and are material for a fragile and quickly crumbling architecture. The aim of thinking by concepts is to substitute for complex states, simpler conditions that may be turned and re-turned in every possible sense, in order the better to discover their relations: whereas here, by the nature of things, the unconscious activity, the labor that operates silently in the lower strata,

is applied to a soil that is full of faults and fissures, and can but project a false light into consciousness.

It has frequently been stated that symbolic thought is thinking by substitution. This formula is admissible only when we recognise that the substitute supposes, nay expects, the *actual* existence of that for which it is substituted. Substitution is valid in consciousness, but not for the total operation. To sum up in a word: the psychology of abstraction and generalisation, is in a great measure the *psychology of the unconscious*.

We have merely studied general ideas in so far as they have an assignable origin in experience, and do not transcend its limits. Are there, as some maintain, notions anterior to any sensory intuition—that can by no means nor effort be derived from empirical data? It is not our part to discuss this question. The thesis—whether or no it be legitimate—is a contention in favor of innate ideas, and in whatever fashion it is conceived (*à priori* forms, hereditary disposition, cerebral conformation), it is the problem of the ultimate constitution of human intelligence, which we have rigorously eliminated from our present subject.

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