

PART III.

AN ENQUIRY INTO THE PHYSICAL CAUSES OF FEELING,
INTO THE FORCE WHICH PRODUCES ACTIONS, AND,
LASTLY, INTO THE ORIGIN OF THE ACTS OF INTELLI-
GENCE OBSERVED IN VARIOUS ANIMALS.

INTRODUCTION.

IN the second part of this work, I have endeavoured to throw light on the physical causes of life, on the conditions necessary for its existence, and on the origin of that exciting force of vital movements, without which no body could actually possess life.

I now propose to enquire what feeling may be, how the special organ giving rise to it (the nervous system) produces the wonderful phenomenon of sensations, how sensations themselves produce ideas through the medium of the brain, and how ideas cause in that organ the formation of thoughts, judgments and reasoning ; in short, of acts of intelligence that are still more wonderful than sensations.

“ But,” it is said, “ the functions of the brain are of a different order from those of the other viscera. In the latter causes and effects are of the same nature (physical nature). . . .

“ The functions of the brain are of quite a different order : they consist in receiving sense impressions through the nerves, in transmitting them immediately to the mind, in preserving the traces of these impressions, and in reproducing them with varying rapidity, clearness and fulness whenever the mind needs them in its operations or the laws of association of ideas recall them ; lastly, in transmitting to the muscles again through the medium of nerves the commands of the will.

“ Now these three functions involve a mutual influence, which has always remained incomprehensible, between divisible matter and the indivisible ego. This has always constituted an impassable hiatus in the system of our ideas, and the stumbling block of all philosophies ; they involve us moreover in a further difficulty that has no necessary connection with the first : not only do we not understand nor ever shall understand how impressions on the brain can be perceived by the mind and produce images in it ; but however refined our means of investigation, these traces cannot be made visible in any way ; and we are entirely ignorant of their nature, although the effect of age and diseases on the memory leave us in no doubt either as to their

existence or their seat." (*Rapport à l'Institut sur un Mémoire de MM. Gall et Spurzheim*, p. 5.)

It is, I think, a little rash to fix limits to the conceptions which the human intellect may reach, or to specify the boundaries and the powers of that intellect. How indeed can we know that man will never obtain such knowledge, nor penetrate these secrets of nature? Do we not know that he has already discovered many important truths, some of which seemed to be entirely beyond him?

It is more rash, I repeat, to try to determine positively what man may know and what he never can know, than to study the facts, examine the relations existing between various physical bodies, draw all possible inferences, and then make continuous efforts to discover the causes of natural phenomena; even when the coarseness of our senses does not allow us to reach anything more than moral certainties.

If we were concerned with objects outside nature, with phenomena that are neither physical nor the result of physical causes, the subject would doubtless be beyond the human intellect; for it can never obtain a grasp of anything external to nature.

Now, since in this work we are dealing mainly with animals, and since observation teaches us that there are among them some which possess the faculty of feeling, which form ideas and judgments and carry out intelligent acts, which, in short, have memory, I wish to ask what is the peculiar entity called mind in the passage cited above; a remarkable entity which is alleged to be in relation with the acts of the brain, so that the functions of this organ are of a different order from those of the other organs of the individual.

In this factitious entity, which is not like anything else in nature, I see a mere invention for the purpose of resolving the difficulties that follow from inadequate knowledge of the laws of nature: it is much the same thing as those universal catastrophes, to which recourse is had for giving answers to certain geological questions. These questions puzzle us because the procedure of nature, and the different kinds of transformations that she is always producing, are not yet ascertained.

With regard to the traces impressed on the brain by ideas and thoughts, what matters it that these traces cannot be perceived by our senses, if, as is agreed, observations exist which leave us in no doubt as to their presence and their seat: do we see any more clearly the way in which other organs perform their functions, and, to take a single example, do we see any more clearly how the nerves set the muscles in action? Yet we cannot doubt that nervous influence is indispensable for the performance of muscular movements.

In the sphere of nature, knowledge is extremely important for us and yet very difficult to obtain in any better form than moral

certainties; such knowledge can, I believe, only be attained by the following method.

Do not let us be imposed upon by dogmatic utterances which are nearly always ventured with little thought; let us carefully collect such facts as we can observe, let us make experiments wherever we can, and when experiment is impossible let us marshal all the inferences that we can draw from analogy, and let us nowhere make a dogmatic pronouncement: by this method we shall be able gradually to attain a knowledge of the causes of many natural phenomena, including perhaps even those that now appear to us the most incomprehensible.

Since, then, the limits of our knowledge as to what occurs in nature neither are nor can be fixed, I shall endeavour, by the use of such facts as have been collected, to determine in this third part what are the physical causes which confer on certain animals the faculty of feeling, of producing for themselves the movements which constitute their actions, and, lastly, of forming ideas and of comparing these ideas, so as to obtain judgments: in short, of performing various intelligent acts.

The principles which I shall set forth on this matter will as a rule be such as to fill us with an inward moral conviction, although it is impossible to prove positively their accuracy. It seems that, with regard to many natural phenomena, this order of knowledge is alone possible for us; and yet its importance cannot be called in question in innumerable cases where we are called upon to form judgments.

If the physical and the moral have a common origin, if ideas, thought and even imagination are only natural phenomena, and therefore really dependent on organisation, then it must be chiefly the province of the zoologist, who makes a special study of organic phenomena, to investigate what ideas are, and how they are produced and preserved, in short, how memory renews them, recalls them and makes them perceptible once more; from this it is only a short way to perceiving what are thoughts themselves, for thoughts can only be invoked by ideas; lastly, by following the same method and building up from original perceptions, it may be possible to discover how thoughts give rise to reasoning, analysis, judgments and the will to act, and how again numerous acts of thought and judgments may give birth to imagination, a faculty so fertile in the creation of ideas that it even seems to produce some which have no model in nature, although in reality they must be derived from this source.

If all the acts of the intellect, into the causes of which I am now enquiring, are only phenomena of nature, that is to say, acts of the organisation, may I not hope, by acquiring a thorough knowledge of the only means by which the organs perform their functions, to discover how the intellect may give rise to the formation of ideas and

preserve their traces or impressions for a longer or shorter period, and finally, by means of these ideas, carry out thought, etc., etc. ?

It cannot now be doubted that the acts of the intellect are exclusively dependent on organisation, since it is known that even in man disturbances in the organs which produce these acts involve others in the acts themselves.

An investigation of the causes of which I spoke above appears therefore to me to be obviously possible : I have given attention to the subject ; I have devoted myself to an investigation of the only method by which nature can have brought about the phenomena in question ; and it is the result of my meditations on this subject that I am now about to present.

The essential point is that, in every system of animal organisation, nature has but one method for making the various organs perform their appropriate functions.

These functions indeed are everywhere the result of the relation between fluids moving in the animal, and the parts of its body which contain these fluids.

There are everywhere moving fluids (some containable, others uncontainable) which act upon the organs ; and there are also everywhere supple parts, which are sometimes in erethism and react on the fluids which affect them, and which are sometimes incapable of reacting ; but in either case they modify the movement of the fluids taking place among them.

Thus, when the supple parts of organs are capable of being animated by orgasm and of reacting on the contained fluids which affect them, the various resulting movements and changes, both in the fluids and the organs, produce phenomena of organisation which have nothing to do with feeling or intelligence ; but when the containing parts are so soft as to make them passive and incapable of reacting, the subtle fluid moving in these parts, and modified by them in its movements, gives rise to the phenomena of feeling and intelligence as I shall endeavour to prove in this Part.

We have therefore to deal only with the relations existing between the concrete supple and containing parts of an animal, and the moving fluids (containable or uncontainable) which act on these parts.

This well-known fact has been for me as a beam of light ; it guided me in the research that I have sketched out, and I soon perceived that the intelligent acts of animals are, like their other acts, phenomena of animal organisation, and that they take their origin from the relations existing between certain moving fluids and the organs which produce these wonderful acts.

What matters it that these fluids, whose extreme tenuity prevents

us from seeing them or even keeping them in a vessel for making experiments with, only manifest their existence by their effects ? These effects constitute a cogent proof that no other cause could have produced them. It is, moreover, easily ascertained that the visible fluids, which penetrate the medullary substance of the brain and nerves, are only nutritive and adapted for secretion ; but that they are too slow in their movements to give rise to the phenomena either of muscular movement, feeling, or thought.

In the light of these principles, which restrain the imagination within its proper limits, I shall first show how nature originally succeeded in creating the organ of feeling, and by its means the force productive of actions : I shall afterwards proceed to consider how (by means of a special organ for intellect), ideas, thoughts, judgments, memory, etc., may have arisen in the animals which possess such an organ.

CHAPTER I.

OF THE NERVOUS SYSTEM, ITS FORMATION, AND THE VARIOUS SORTS OF FUNCTIONS THAT IT CAN FULFIL.

THE nervous system, in man and the most perfect animals, consists of various quite distinct special organs and even systems of organs, which are closely connected and form a very complicated whole. It has been supposed that the composition of this system is everywhere the same, except for its greater or lesser development, and the differences of size, form, and situation involved by the various types of organisation. On this theory the various sorts of functions, to which it gives rise in the most perfect animals, were all regarded as being characteristic of it throughout all animal organisation.

This manner of regarding the nervous system throws no light on the nature of the organs in question, on the mode of their origin, on the growing complexity of their parts in proportion to the complication and perfection of animal organisation, nor, lastly, on the new faculties which it confers on animals in proportion to its development. On the contrary, instead of enlightening physiologists on these matters, it leads them to attribute everywhere to the nervous system in various degrees of concentration the faculties which that system confers on the most perfect animals, and this is entirely without foundation.

I shall therefore endeavour to prove: (1) That this system of organs cannot be a property of all animals; (2) that at its origin, that is, at its greatest simplicity, it only confers on the animals which possess it the one faculty of muscular movement; (3) that afterwards, when more highly developed, it endows animals not only with muscular movement but also with feeling; (4) that lastly, on reaching completion, it confers on the animals which possess it the faculties of muscular movement, of experiencing sensations, and of forming ideas, comparing them together, and producing judgments; in short, of having an intellect whose development is proportional to the perfection of organisation.

Before setting forth the proofs of these theories, let us see what general idea we can form of the nature and arrangement of the various parts of the nervous system.

This system, wherever it occurs in animals, presents a main medullary mass, either divided into separate parts or concentrated into a single whole of varying shape, and also nervous threads which run into this mass.

All these organs are composed of three kinds of substances of very different character, viz. :

1. A very soft medullary pulp of peculiar character.

2. An aponeurotic investment, which surrounds the medullary pulp and provides sheaths to its prolongations and threads, including even the finest. The nature and properties of this investment are different from those of the pulp which it encloses.

3. A very subtle invisible fluid, which moves in the pulp without requiring any visible cavity, and which is kept in at the sides by the sheath, through which it cannot pass.

Such are the three kinds of substances which compose the nervous system, and which produce the most astonishing of all organic phenomena as a result of their arrangement, relations and the movements of the subtle fluid contained within the system.

It is known that the pulp of these organs is a very soft medullary substance, white on the inside, greyish on its outer layer, not sensitive, and apparently albumino-gelatinous in character. It forms, by means of its aponeurotic sheaths, threads and cords which proceed to the larger masses of this medullary substance containing the nucleus (simple or divided), or centre of communication of the system.

Both for the performance of muscular movement and for sensations, it is necessary that this system of organs should have a nucleus or centre of communication for the nerves. As a matter of fact, in the first case the subtle fluid which acts upon the muscles issues from a common nucleus and travels towards the parts which it has to actuate; and, in the second case, the same fluid, being set in motion by the affective cause, starts from the extremity of the affected nerve and travels towards the centre of communication, there producing the disturbance which gives rise to sensations.

A nucleus or centre of communication, in which the nerves terminate, is therefore absolutely necessary in order that the system may carry on any of its functions; and indeed we shall see that without it the individual would not become cognisant of the acts of the organ of intellect. Now this centre of communication is situated in some part of the main medullary mass, which always constitutes the basis of the nervous system.

The threads and cords of which I spoke above are nerves; and the main medullary mass, which contains the centre of communication of the system, consists in some invertebrates either of separate ganglia or of a ganglionic longitudinal cord; in the vertebrates, it forms the spinal cord and the medulla oblongata which is united to the brain.

Wherever a nervous system exists, however simple or imperfect it may be, there is always a main medullary mass in some form or other; for it constitutes the basis of the system and is essential to it.

It is in vain to deny this truth by such arguments as the following:

1. That it is possible to remove entirely the brain of a tortoise or a frog, which nevertheless continue to exhibit movements showing that they still have sensations and a will: I reply, that this operation only destroys a part of the main medullary mass, and not that part which contains the centre of communication or *sensorium commune*; for this is not contained in the two hemispheres which form the bulk of what is called the brain;

2. "That there are insects and worms, which when cut into two or more pieces, promptly form so many new individuals, each having its own system of sensation and its own will"; I reply again, that as regards insects the alleged fact is untrue, that no experiment has shown that when an insect is cut in two there may result two individuals both capable of life; and even if it were so, each half of the insect would still possess a main medullary mass in its share of the ganglionic longitudinal cord;

3. "That the more evenly the nervous substance is distributed, the less essential is the rôle of the central parts."¹ I reply, for the last time, that this assertion is erroneous; that it has no facts to support it; and that it is only made through ignorance of the functions of the nervous system. Sensibility is neither the property of nervous substance nor any other substance, and the nervous system can only enter upon its functional existence when it is composed of a main medullary mass from which nervous threads take rise.

Not only can the nervous system have no functional existence unless it is composed of a main medullary mass which contains one or more nuclei for starting muscular excitement and from which various nerves proceed to the parts, but we shall also see in Chapter III. that the faculty of feeling in any animal can only arise when the medullary mass contains a single nucleus or centre of communication, to which the nerves of the sensitive system travel from all parts of the body.

It is true that the extreme difficulty of following these nerves to their centre of communication, has led some anatomists to deny the existence

¹ See *L'Anatomie comparée* of M. Cuvier, vol. ii., p. 94; and the *Recherches sur le Système nerveux* of MM. Gall and Spurzheim, p. 22.

of any common nucleus that is essential to the production of feeling; they consider feeling to be an attribute of all the nerves, including even their smallest parts; and, to strengthen their view as to the absence of any centre of communication in the sensitive system, they allege that the need for finding a definite situation for the soul has caused the invention of this common nucleus or circumscribed locality to which all sensations are conducted.

It is quite enough to believe that man possesses an immortal soul; there is no occasion for us to study the seat and limits of this soul in the individual body, nor its connection with the phenomena of organisation: all that we can ever say on this subject is baseless and purely imaginary.

If we are studying nature she alone should occupy our attention; and we should confine ourselves exclusively to the examination of the facts which she presents, in our endeavour to discover the physical laws which control the production of these facts; lastly, we ought never to introduce into our theories any subjects that are outside nature, and about which we shall never be able to know anything positive.

For my own part, I only study organisation in order to arrive at an understanding of the various faculties of animals. I am convinced that many animals possess feeling, and that some of them also have ideas and perform intelligent acts; and I hold that the causes for these phenomena should be sought in purely physical laws. I always make a rule of this in my own researches, and I may add that I am not only convinced that no kind of matter can in itself possess the faculty of feeling, but I am also convinced that this faculty in such living bodies as possess it consists only in a general effect which is set up in an appropriate system of organs, and that this effect cannot occur unless the system possesses a single nucleus or centre of communication, in which terminate all the sensitive nerves.

In the case of vertebrates, it is at the anterior extremity of the spinal cord, in the medulla oblongata itself or perhaps its annular protuberance, that the *sensorium commune* is lodged; that is to say, the centre of communication of the nerves which give rise to the phenomenon of sensibility; for it is towards some point at the base of the brain that these nerves appear to converge. If the centre of communication were farther forward in the interior of the brain, acephalic animals, whose brain had been destroyed, would be devoid of feeling and unable even to live.

But this is not the case: in animals which possess any faculty of intelligence, the nucleus for feeling is confined to some part of the base of what is called their brain; for this name is given to the entire

medullary mass contained within the cranial cavity. The two hemispheres, however, which are confused with the brain, should be distinguished from it; because they form together a special organ added on to the brain, have special functions of their own and do not contain the centre of communication of the sensitive system.

Although the true brain, that is to say, the medullary part which contains the nucleus of sensations and to which the nerves lead from the special senses, is difficult to identify and define in man and intelligent animals, on account of the contiguity or union between this brain and the two hemispheres which cover it, it is none the less true that these hemispheres constitute an organ specially related to the functions that it performs.

Indeed it is not in the brain properly so-called that ideas, judgments, thoughts, etc., are formed; but it is in the organ superimposed on it, consisting of the two hemispheres.

Nor is it in the hemispheres that sensations are produced; they have no share in it, and the sensitive system exists satisfactorily without them; these organs may therefore undergo great degeneration without any injury to feeling or life.

I now revert to the general principles concerning the composition of the various parts of the nervous system.

The nervous threads and cords, the ganglionic longitudinal cord, the spinal cord, the medulla oblongata, the cerebellum, the cerebrum and its hemispheres;—all these parts have, as I have already observed, a membranous and aponeurotic investment which serves as a sheath, and which by its peculiar nature retains within the medullary substance the special fluid that moves about there; but at the extremities of the nerves where they terminate in the parts of the body, these sheaths are open and allow the nervous fluid to communicate with the parts.

Details about the number, shape and situation of the parts I have referred to, belong to the sphere of anatomy; an exact description may be found in works which deal with this sphere of our knowledge. Now since my purpose here is simply to investigate the general principles and faculties of the nervous system, and to enquire how nature first conferred it on such animals as possess it, I need not enter into any of the details that are known about the parts of this system.

FORMATION OF THE NERVOUS SYSTEM.

We certainly cannot positively determine the manner in which nature brought the nervous system into existence; but it is quite possible to ascertain the conditions which were necessary for this purpose. When once we have ascertained and studied these con-

ditions, we may be able to conceive how the parts of the system were formed, and how they were filled with the subtle fluid which moves within them and enables them to carry out their functions.

We may suppose that when nature had advanced so far with animal organisation that the essential fluid of animals had become highly animalised, and the albumino-gelatinous substance been formed, this substance would be secreted from the animal's chief fluid (blood, or its substitute) and deposited in some part of the body : now observation shows that this first occurs in the shape of several small separate masses, and afterwards as a larger mass which becomes lengthened into a ganglionic cord and occupies nearly the whole length of the body.

The cellular tissue is modified by this mass of albumino-gelatinous substance, and so provides it with its investing sheath, and that of its various prolongations or threads.

Now on examining the visible fluids which move or circulate in the bodies of animals, I find that, in the animals with the simplest organisations, these fluids are much less complex and contain much fewer principles than is the case in the more perfect animals. The blood of a mammal is a more complex and animalised fluid than the whitish serum of insects ; and this serum again is a more complex fluid than that watery matter which moves in the bodies of polyps and infusorians.

This being so, I am justified in the belief that those invisible and uncontainable fluids which keep up irritability and vital movements in the most imperfect animals, are the same as those existing in animals with a highly complex and perfected organisation. In the latter, however, they undergo so great a modification as to be changed into containable fluids, though still invisible.

It appears indeed that an invisible and very subtle special fluid, which is modified during its presence in the blood of animals, is continually separating out to spread through the nervous medullary masses, and incessantly makes good the wastage due to the various activities of this system of organs.

The medullary pulp of the nervous system, and the subtle fluid moving within it, will thus only be formed when the complexity of animal organisation has reached a sufficient development for the manufacture of these substances.

Just as the internal fluids of animals are progressively modified, animalised and compounded in correspondence with the progress in the complexity and perfection of organisation ; so too the organs and solid or containing parts of the body are gradually compounded and diversified in the same way and by the same cause. Now the nervous fluid, which becomes containable after its secretion by the blood,

is distributed in the albumino-gelatinous substance of the nerve tissue, for this substance is a natural conductor of it and is adapted for holding it and letting it move freely about ; the fluid is kept in by the aponeurotic sheaths which invest this nervous tissue, since these sheaths do not permit of the passage of the fluid.

Thereafter, when the nervous fluid is distributed throughout that medullary substance which was originally arranged in separate ganglia and afterwards in a cord, its movements probably thrust out portions which become elongated into threads and it is these threads which constitute the nerves. It is known that they spring from their centre of communication, and issue in pairs either from a ganglionic longitudinal cord or a spinal cord at the base of the brain, and that they then proceed to their termination in the various parts of the body.

This no doubt was the method employed by nature for the formation of the nervous system : she started by producing several small masses of medullary substance when the animal organisation had advanced sufficiently to enable her to do so : she then collected them into one chief mass ; through this mass immediately spread the nervous fluid, which had become containable and was kept in by the nervous sheaths : it was then that its movements gave rise to the medullary mass in question, and to the nervous threads and cords which issue from it to the various parts of the body.

In accordance with this theory, nerves cannot exist in any animal unless there is a medullary mass containing their nucleus or centre of communication ; hence those isolated whitish threads which do not lead to a medullary mass are not to be regarded as nerves.

I may add to these reflections on the formation of the nervous system, that if the medullary substance has been secreted by the chief fluid of the animal, it is through the agency of the capillary extremities of certain arterial vessels in red-blooded animals ; and since the extremities of these arterial vessels must be accompanied by the extremities of venous vessels, all these vascular extremities, containing coloured blood, are buried in the medullary substance which they have produced, and give rise to the greyish colour, which this medullary substance presents in its external layer : sometimes, indeed, as a result of certain evolutions taking place in the encephalon as it develops, the nutritive organs have penetrated so deeply that the greyish medullary substance is central in some localities, and surrounded in great part by that which is white.

I may add further, that if the extremities of certain arteries have secreted and then maintained the medullary substance of the nervous system, these same vascular extremities may likewise have deposited the nervous fluid which separates off from the blood and is continually

poured into that medullary substance which is so well adapted to contain it.

Lastly, I shall conclude these reflections by some remarks on the development of the main medullary mass and of the swellings and expansions which are found in certain parts of that mass. These expansions are proportional to the formation and development of the special systems which compose the common and perfected nervous system.

In the main medullary mass of every nervous system, the particular part which to some extent gave origin to the rest, need not necessarily be larger than the other parts which have grown from it; for the thickness and size of these other parts are always dependent on the use which the animal makes of the nerves that issue from them. I have given sufficient proof of this in the case of all the other organs: the more they are exercised the more they become developed, strengthened, and enlarged. It is because this law of animal organisation has not been recognised, or because no attention had been paid to it, that it is believed that the part of the medullary mass which produces the other parts must of necessity be larger than them.

In vertebrates, the main medullary mass consists of the brain and its accessories, the medulla oblongata and the spinal cord. Now it appears that the part of this mass which produced the rest is really the medulla oblongata; for it is from this part that issue the medullary appendages (the peduncles and crura) of the cerebellum and cerebrum, the spinal cord, and, lastly, the nerves of the special senses. Yet the medulla oblongata is in general smaller or less thick than the brain which it has produced, or the spinal cord which proceeds from it.

Whereas, on the one hand, the brain and its hemispheres are employed in acts of feeling and intellect, while the spinal cord only serves for the excitation of muscular movements¹ and the performance of organic functions; and whereas, on the other hand, the continued use or exercise of the organs causes in them a remarkable development; it must follow that in man, who is continually exerting his senses and intellect, the brain and hemispheres should become much enlarged while the spinal cord, which in general is little used, can only acquire moderate dimensions. Finally, since the chief muscular movements of man are those of the arms and legs, we should expect to find a conspicuous swelling in his spinal cord at the exits of the crural and brachial nerves, and this is confirmed by observation.

In those vertebrates, on the contrary, which make but little use of

¹ With regard to the function of the spinal cord in providing nervous influence to the organs of movement, recent experiments have shown that poisons which act on this cord do actually cause convulsions and attacks of tetanus before producing death.

their senses and particularly of their intellect, and which are chiefly given up to muscular movement, the brain and especially the hemispheres should have undergone slight development, whereas the spinal cord is likely to acquire considerable dimensions. Thus fishes, which are largely confined to muscular movement, have a very large spinal cord and a correspondingly small brain.

Among the invertebrates some have a ganglionic longitudinal cord, instead of a spinal cord, throughout their length, such as the insects, arachnids, crustaceans, etc.; because these animals carry out much movement, and the cord is thereby strengthened and swollen where each pair of nerves issues.

Lastly the molluscs, which have only feeble supports for their muscles and generally only carry out slow movements, have no spinal cord nor longitudinal cord, and exhibit nothing more than a few scattered ganglia from which issue nervous threads.

In accordance with this theory, we may conclude that in the vertebrates the nerves and main medullary mass cannot have been developed from above downwards, that is, from the superior terminal part of the brain; any more than the brain itself can be a production of the spinal cord, that is, of the inferior or posterior part of the nervous system; but that these various parts spring originally from one which produced the rest. Probably this one is the medulla oblongata. Some point in the neighbourhood of its annular protuberance must have given origin to the cerebral hemispheres, the cerebellar peduncles, the spinal cord and the special senses.

It matters not that the medullary bases of the hemispheres are narrowed and much less bulky than the hemispheres themselves; and that the same applies to the peduncles of the cerebellum, etc. It is plain to all that the gradual development of these organs, in proportion to their more frequent use, may have caused in them an expansion which makes them much larger than their roots!

These reflections on the formation of the nervous system are doubtless somewhat indefinite; but they suffice for my purpose, and seem to me interesting, because they are accurate and in accordance with the observed facts.

FUNCTIONS OF THE NERVOUS SYSTEM.

The nervous system of the most perfect animals is, as we know, highly complicated, and may consequently fulfil various kinds of functions, which confer on the animals possessing them as many special faculties. Now before proving that this system is limited to certain animals and not common to all; and before stating what are the faculties conferred by it in the various degrees of complexity of

animal organisation, we must say a word about its functions and the faculties resulting from them. They are of four different kinds, viz. :

1. That of instigating muscular activity ;
2. That of giving rise to feeling or to the sensations which constitute it ;
3. That of producing the emotions of the inner feeling ;
4. That, lastly, of forming ideas, judgments, thoughts, imagination, memory, etc.

I shall endeavour to show that the functions of the nervous system which give rise to these four kinds of faculties are very different in character, and that they are not all performed by the animals which possess this system.

The activities of the nervous system which give rise to muscular movement are altogether distinct from and even independent of those which produce sensations : thus we may experience one or more sensations without any muscular movement ensuing, and we may set in action various muscles without any resulting sensation. These facts are worthy of note and they are unquestionably well-founded.

Muscular movement cannot be executed without nervous influence ; and although we do not know how this influence works, we are justified by many facts in the belief that it may be by an emission of nervous fluid which starts from a centre or reservoir and travels down the nerves to the muscles which have to be actuated. In this function of the nervous system then, the movements of the subtle fluid which works the muscles take place from some centre or nucleus towards the parts that have to carry out some action.

It is not only to set the muscles in action that the nervous fluid travels from its nucleus or reservoir towards the parts which have to carry out movements ; this emission also takes place apparently in order to assist various organs in the performance of functions, where no distinct muscular movement is involved.

Since these facts are well known I shall not dwell further upon them ; but shall adopt the conclusion that the nervous influence, which gives rise to muscular activity and which aids various organs in the performance of their functions, works by an emission of nervous fluid which travels from some centre or reservoir to the parts requiring to be actuated.

On this subject I may record a well-known fact that is relevant to the matter now in hand. It is as follows :

With regard to the nervous fluid which leaves its reservoir on its way to the parts of the body, one portion of this fluid is subject to the will of the individual who starts it moving, by means of the emotions of his inner feeling, when stimulated by some requirement ; whereas

the other portion is regularly distributed, independently of the individual's will, to those parts of the body which have to be kept incessantly in action for the preservation of life.

It would be highly inconvenient if the movements of our heart or arteries, or the functions of our viscera or secretory or excretory organs, were dependent on our will ; but it is equally important for the satisfaction of all our requirements that we should have at our disposal some portion of our nervous fluid, for despatching to the regions that we wish to actuate.

It appears that the nerves which continually convey the nervous influence to the vital organs and to the muscles that are independent of the individual, have a firmer or denser medullary substance than the other nerves ; or have some other distinguishing peculiarity, as a result of which not only does the nervous fluid move less rapidly and less freely, but is also to a great extent protected from those general agitations caused by the emotions of the inner feeling. If it were otherwise, every emotion would interfere with the nervous influence necessary to the essential organs and vital movements, and would endanger the life of the individual.

Those nerves, on the contrary, which convey the nervous influence to the muscles dependent on the individual, allow to the subtle fluid which they contain every liberty and rapidity of movement, so that the emotions of the inner feeling easily set these muscles in action.

Observation justifies us in the belief that the nerves which serve for the excitation of muscular movement issue from the spinal cord in vertebrates, from the ganglionic longitudinal cord in such invertebrates as have one, and from the separate ganglia in those which have neither a spinal cord nor a ganglionic longitudinal cord. Now these nerves, destined for muscular movement, have no close connection with the sensitive system, in animals which have feeling, and when they are injured they produce spasmodic contractions and do not interfere with the system of sensations.

Hence there are grounds for the belief that, of the various special systems which compose the nervous system at its highest perfection, that which is engaged in muscular excitation is distinct from that which serves for the production of feeling.

Thus the function of the nervous system, which consists in producing muscular activity and the performance of the various vital functions, can only be fulfilled by the dispatch of the subtle fluid of the nerves from the reservoir to the various regions.

But that other function of the nervous system which induces feeling is of quite a different character ; for the production of a sensation cannot occur without nervous influence, and it requires that the subtle

fluid of the nerves should always travel from the point of the body that is affected towards the nucleus or centre of communication of the system and there start an agitation which affects all the nerves serving for feeling; their fluid then reacts and sensation is produced.

Not only do these two sorts of functions of the nervous system differ, in that there is no sensation produced by any muscular movement and that there is not necessarily any muscular movement for the production of a sensation; but these functions differ also, as we have just seen, by the fact that in one the nervous fluid is driven from its reservoir to the parts, whereas in the other it is driven from the parts to the nucleus or centre of communication of the system of sensations. These facts are manifest, although we cannot witness the movements which cause them.

The function of the nervous system which consists in bringing about emotions of the inner feeling, and which works by means of a general disturbance of the free mass of nervous fluid—a disturbance which is followed by no reaction and therefore produces no distinct sensation—is yet quite peculiar and very different from the two that I have named; in the account that I shall give of it (Chapter IV.) we shall find that its study is very curious and interesting.

Whereas the function, by which the nervous system sets the muscles in action and assists the performance of organic functions, is different from the function by which this system produces feeling as also from that which constitutes the emotions of the inner feeling, I have now to remark that when the system is sufficiently developed to have obtained that special accessory organ constituted by the wrinkled cerebral hemispheres, it then has the faculty of performing a fourth kind of function, very different from the three others.

Indeed, by means of the accessory organ that I have mentioned, the nervous system gives rise to the formation of ideas, judgments, thoughts, will, etc.; phenomena which assuredly could not be produced by the first three kinds of functions. Now the accessory organ, in which are carried out functions capable of giving rise to these phenomena, is only a passive organ, on account of its extreme softness; and it receives no excitation because none of its parts would be capable of reacting; but it preserves the impressions received, and these impressions modify the movements of the subtle fluids in its numerous parts.

An ingenious idea, though destitute of proof or any adequate basis, has been expressed by Cabanis, who said that the brain acts on the impressions which the nerves conveyed to it as the stomach acts on the food poured in from the oesophagus; that it digests them in its own way, and that when agitated by movement transmitted to it, it

reacts and that this reaction gives birth to a perception which thereafter becomes an idea.

This does not appear to me to be based on a study of the faculties of the cerebral pulp; and I cannot convince myself that so soft a substance is really active, or that it can truly be said to react and give rise to perception when agitated by the movements transmitted to it.

This mistake arises, in the first place, from the fact that Cabanis took no note of the nervous fluid, and was obliged in his mind to attribute the functions of that fluid to the nervous tissue in which it moves; and in the second place, from the fact that he confused sensations with intelligence, whereas the nature of these two organic phenomena is essentially different, and demands in each case an individual system of organs for its production.

Thus there are four very different kinds of functions carried on by the perfected nervous system, that is, when it is completely developed and provided with its accessory organ; but seeing that the organs which give rise to these various functions are not the same, and seeing that they have only come into existence successively, nature formed those which are adapted to muscular movement before those which give rise to sensation, and these latter before setting up the means for producing emotions of the inner feeling; she at length completed the perfection of the nervous system by making it capable of producing the phenomena of intelligence.

We shall now see that all animals neither have nor can have a nervous system, and, moreover, that those which possess this system do not necessarily derive from it the four kinds of faculties named.

THE NERVOUS SYSTEM IS LIMITED TO CERTAIN ANIMALS.

Doubtless it is only in animals that the nervous system can exist; but does it follow thence that they must all possess it? There are certainly many animals whose organisation is such that they could not possibly have this system of organs; for the system consists necessarily of two kinds of parts, viz.: a main medullary mass, and various nervous threads which unite with it. Now this cannot exist in the elementary organisations of a great many known animals. It is obvious, moreover, that the nervous system is not essential to life, since all living bodies do not possess it, and it would be vainly sought among plants. This system, then, can only have become necessary to those animals in which nature was able to establish it.

In Chapter IX. of Part II., p. 273, I have already shown that the nervous system is peculiar to certain animals: I shall now give a further proof of it by showing the impossibility that all animals should

possess this system of organs; whence it follows that those which have not got it can enjoy none of the faculties which it produces.

When people have said that, in animals without nervous threads (such as the polyps and infusorians), the medullary substance which yields sensations was distributed and dissolved in every part of the body, instead of being collected into threads; and that from this it followed that each fragment of these animals became an individual endowed with its particular ego; they have probably paid no attention to the invariable characteristic organic function, which is always due to relations between the containing parts and contained fluids, and to the movements resulting from these relations. There was no adequate knowledge of the essential facts with regard to the functions of the nervous system; it was not known that these functions only worked by causing the movement or transport of a subtle fluid, either from a nucleus towards the parts or from the parts towards the nucleus.

The nervous system cannot then exist, nor fulfil the least of its functions, unless it consists of a medullary mass with a nucleus for the nerves, and also of nervous threads which run into this nucleus. Moreover the medullary matter, or any other animal substance, cannot possess in itself the faculty of producing sensations, as I hope to prove in the third chapter of this part; hence this medullary substance when dissolved as alleged in every part of an animal's body would not give rise to feeling.

If the nervous system at its greatest simplicity is necessarily composed of two kinds of parts, viz. a main medullary mass and nervous threads running into it; we may feel how great was the progress required in the complexity of animal organisation, starting from the *Monas*, which is the simplest and most imperfect of known animals, before nature could have attained the formation of such a system of organs even in its greatest imperfection. Yet when this system begins, its complexity and perfection are still very far from what we find in the most perfect animals; and before it could begin, animal organisation had already made much progress in development and complexity.

To convince ourselves of this truth, let us examine the products of the nervous system at its chief stages of development.

THE NERVOUS SYSTEM IN ITS SIMPLEST STATE PRODUCES NOTHING BUT MUSCULAR MOVEMENT.

I have, it is true, nothing more than a mere opinion to offer on this subject; but it is based on considerations of such importance and weight that it may at least be regarded as a moral truth.

If the procedure of nature is attentively examined, it will be seen that in the creating or giving existence to her productions, she has

never acted suddenly or by a single leap, but has always worked by degrees towards a gradual and imperceptible development: consequently all her products and transformations are everywhere clearly subject to this law of progress.

If we follow the operations of nature, we shall indeed see that she created by successive stages all the tissues and organs of animals, that she gradually brought them to completion and perfection, and that in the same way by slow degrees she modified, animalised, and compounded all the internal fluids of the animals she had brought into existence; so that in course of time they were brought to the condition in which we now see them.

The nervous system at its origin is assuredly in its greatest simplicity and least perfection. This kind of origin is common to it, as to all the other special organs, which also began in their most extreme state of imperfection. Now it cannot be doubted that, in its greatest simplicity, the nervous system gives to the animals possessing it less numerous and lofty faculties than it bestows on the more perfect animals, where it has reached its highest complexity and acquired its accessories. We only have to observe the facts to recognise the truth of this statement.

I have already proved that when the nervous system is in its greatest simplicity, it necessarily has two kinds of parts, viz.: a main medullary mass and nervous threads which run into this mass; but this same medullary mass may at first exist without giving rise to any special sense, and it may be divided into separate parts, to each of which run nervous threads.

Such appears to be the case in animals of the class of radiarians, or at least in those of the division of echinoderms in which a nervous system is supposed to have been discovered; the system would be reduced to separate ganglia, communicating together by threads and sending out others to the parts.

If the observations, which affirm this state of the nervous system, are well-founded, we have here the system in its greatest simplicity. It possesses several centres of communication for the nerves, that is to say, as many nuclei as there are separate ganglia; lastly, it does not give rise to any of the special senses, not even to sight, which is certainly the first to show itself unequivocally.

By special senses I mean those which result from special organs such as sight, hearing, smell, and taste; as to touch, it is a general sense, a type no doubt of all the rest, but needing no special organ and incapable of being yielded by the nerves until they are competent to produce sensations.

When I come to describe in Chapter III. the mechanism of sensations,

we shall see that none of them can be produced except when the whole animal shares in the general effect, by reason of the complexity of its nervous system and of the single common nucleus for the nerves. If this is the case, it follows that in animals with the most elementary nervous systems, where there are different nuclei for the nerves, no effect or agitation can become generalised through the individuals, no sensation can be produced, nor can the separate medullary masses give rise to any special sense. If these separate medullary masses communicate together by threads, it is in order to secure the free distribution of the nervous fluid within them.

Yet as soon as the nervous system exists, however simple it may be, it must be capable of performing some function; we may therefore hold that it has an effective action, even when it cannot yet give rise to feeling.

If we reflect that, for the excitation of muscular movement, which is the least of the faculties of the nervous system, a lower degree of complexity and less extent of its parts are required than for the production of feeling, and moreover that separate centres of communication are no bar to the nervous fluid conveying its influence to the muscles from the individual nuclei, it will then appear very probable that the animals with the simplest nervous systems derive from it the faculty of muscular movement, while yet being destitute of feeling.

Thus on starting the nervous system, nature appears to have formed at first only separate ganglia, communicating together by threads and dispatching other threads to the muscular organs. These ganglia are the main medullary masses; and although they communicate by threads, the separation of the nuclei prohibits the general effect necessary for constituting sensation, though it is not opposed to the excitation of muscular movement: hence the animals which possess such a nervous system are devoid of any special sense.

Having now seen that the nervous system in its extreme simplicity can only produce muscular movement, we shall go on to show that when nature has developed, compounded, and further perfected this system, she proceeded to endow it not only with the faculty of exciting muscular action but also with that of producing feeling.

THE NERVOUS SYSTEM ON REACHING A HIGHER COMPLEXITY PRODUCES BOTH MUSCULAR MOVEMENT AND FEELING.

Of all the systems of organs the nervous system is doubtless that which confers upon animals the most lofty and the most marvellous faculties; but unquestionably it only reaches this point after having acquired its highest possible complexity and development. Prior to this stage, the animals which have nerves and a main medullary

mass present all degrees of perfection in the faculties derived from them.

I have already said that in its greatest simplicity the nervous system appears to have its main medullary mass divided into several separate parts, each of which contains an individual nucleus for the nerves running into it. In this condition the system is not adapted for producing sensations, though it has the faculty of setting the muscles in action: now, does this very imperfect nervous system, which is alleged to have been identified in the radiarians, also exist in the worms? I do not know; and yet there are grounds for the belief, unless the worms are a branch of the animal scale started afresh by spontaneous generation. All I know is that in animals of the class which follow the worms, the nervous system has reached a much higher stage of development, and is quite easy to see and possesses a very definite form.

Indeed, as we follow the animal scale from the most imperfect to the most perfect animals, the first appearance of the nervous system has hitherto seemed to be in the insects; because in all the animals of this class it is very clearly defined, and presents a ganglionic longitudinal cord, which as a rule extends throughout the animal's length and is greatly diversified in shape according to the species of insect and to the state of larva or perfect insect. This longitudinal cord, which ends anteriorly in a subbilobate ganglion, constitutes the main medullary mass of the system, and from its ganglia, which vary in size and proximity, nervous threads proceed to the various parts of the body.

The subbilobate ganglion at the anterior extremity of the ganglionic longitudinal cord of insects has to be distinguished from the other ganglia of the cord, since it gives rise directly to a special sense—that of sight. This terminal ganglion is, then, really a small and very imperfect brain, and doubtless contains the centre of communication of the sensitive nerves, since the optic nerve runs into it. Perhaps the other ganglia of the longitudinal cord are in the same way special nuclei, which provide for the action of the animal's muscles: if these nuclei exist, they would not prevent the general effect which alone, as I have proved, can produce feeling, since they are united by the nervous cord.

Thus in the insects, the nervous system begins to present a brain and single centre of communication for the production of feeling. These animals, by the complexity of their nervous system, possess then two distinct faculties, viz.: that of muscular movement and that of experiencing sensations. These sensations are probably still only simple and fugitive perceptions of the objects which affect them,

but they suffice at least to constitute feeling, although incapable of producing ideas.

This state of the nervous system, which gives rise in insects only to these two faculties, is almost the same in the animals of the five following classes, viz. : arachnids, crustaceans, annelids, cirripedes, and molluscs ; there are apparently no other differences than those involved by a higher development of the two faculties named.

I have not a sufficient number of observations to be able to indicate which of the animals possessing a nervous system, capable of supporting sensations, are liable to experience emotions of their inner feeling. It may be that as soon as the faculty of feeling exists, that which produces emotions arises also ; but the origin of the latter is so vague and imperfect that I believe it can only be recognised in vertebrates. Let us then pass on to a determination of the point in the animal scale at which begins the fourth kind of faculty of the nervous system.

When nature had supplied the nervous system with a true brain, that is, with an anterior medullary swelling, capable of giving rise immediately to at least one special sense such as sight, and of containing in a single nucleus the centre of communication of the nerves, she had not yet completed the development of the system. Indeed she long continued to be concerned with the gradual development of the brain, and started the rudiments of the senses of hearing in the crustaceans and molluscs. But it still continues to be a very simple brain, appearing to be the basis of the organ of feeling, since the sensitive nerves and those of the existing special senses proceed to unite with it.

Indeed the terminal ganglion, which constitutes the brain of insects and of the animals of the following classes up to and including the molluscs, although as a general rule divided by a furrow and to some extent bilobate, still shows no trace of the two wrinkled hemispheres, so susceptible of development, which in the most perfect animals cover over the true brain, viz. that part of the encephalon which contains the nucleus of the sensitive system ; hence the functions, for which these new accessory organs are adapted, cannot be performed in any of the invertebrates.

THE NERVOUS SYSTEM IN ITS COMPLETE STATE GIVES RISE TO MUSCULAR MOVEMENTS, FEELING, THE INNER EMOTIONS AND INTELLIGENCE.

It is only among the vertebrates that nature has arrived at the completion of every part of the nervous system ; and it is probably in the most imperfect of these animals (viz. the fishes) that she started the rudiments of the accessory organ of that brain which consists

of two wrinkled hemispheres, situated opposite one another but united at their base. The hemispheres are commonly confused with the brain properly so called, but this name should be confined to that region which contains the sensitive centre.

The accessory organ which, when highly developed, confers marvellous faculties on animals, rests upon the brain and covers it over entirely, so as commonly to be confused with it ; for as a rule the name of brain is given to the entire medullary mass enclosed in the cavity of the cranium. We should however distinguish between the brain properly so called and its accessory organ, however difficult the distinction may be ; for the accessory organ fulfils altogether special functions, and is neither essential to the brain nor even to the maintenance of life. It therefore deserves a special name, and I propose to call it the *hypocephalon*.

Now this hypocephalon is the special organ in which ideas and all acts of intelligence are carried out ; no such phenomena could take place in the true brain, viz. that part of the main medullary mass which contains the centre of communication of the nerves, and where also the nerves of the special senses meet.

If we regard the brain as that medullary mass which serves as the meeting place for the various nerves, contains their centre of communication, and, in short, comprises the nucleus from which nervous fluid is dispatched to the various parts of the body and to which it is returned when it evokes any sensation, it will then be true to say that the brain even of the most perfect animals is always very small. But when the brain is provided with two hemispheres which cover it over and are more or less confounded with it, and when these wrinkled hemispheres become very large, it is customary to give the name of brain to the whole medullary mass enclosed within the cranial cavity. Hence the whole of this medullary mass is generally regarded as consisting of only a single organ, whereas the fact is that it contains two, whose functions are essentially distinct.

Not only are the hemispheres special organs accessory to the brain, but they are in no way essential to the existence of the brain ; this is placed beyond doubt by many known facts, showing that lesions may occur in them or that they may even be destroyed. With regard to the functions fulfilled by the hemispheres, there must be an emission of nervous fluid, which travels to these organs from its common reservoir or nucleus and enables them to carry out the functions for which they are adapted. Thus we may be sure that it is not the hemispheres themselves which dispatch to the nervous system the special fluid by which it works ; for in that case the entire system would be dependent on them ; which it is not.

From these principles it follows: that all animals which have a nervous system need not necessarily have a brain, since the latter is characterised by the faculty of giving immediate rise to some sense, at all events the sense of sight; that all animals which have a brain need not also have two wrinkled hemispheres, for the smallness of the brain in the last six classes of invertebrates shows that it can only serve for the production of muscular movement and feeling, and not for acts of intelligence; lastly, that all animals, whose brains are provided with two wrinkled hemispheres, possess the power of muscular movement and of feeling, the faculty of experiencing inner emotions, and, in addition, that of forming ideas, making comparisons and judgments and, in short, of carrying out various acts of intelligence, corresponding to the degrees of development of the hypocephalon.

On paying careful attention to the matter we shall feel that the operations which give rise to thoughts, meditations, etc., occur in the superior and anterior part of the brain, that is, in the two wrinkled hemispheres. We can, moreover, make out that these operations are not carried out either in the base of the brain, or in its posterior and inferior part. The two cerebral hemispheres composing what I call the hypocephalon, are therefore really special organs in which acts of intelligence are produced. Thus when we are thinking and fix our attention too long on one subject, we feel a pain in the head, especially in the part that I have mentioned.

It follows from these various principles that among animals which have a nervous system:

1. Those which have no brain, and consequently no special senses nor single centre of communication for the nerves, do not possess feeling but only the faculty of moving their parts by true muscles;

2. Those which have a brain and special senses, but not the wrinkled hemispheres which constitute the hypocephalon, only derive two or three faculties from their nervous system, viz. those of performing muscular movements, of experiencing sensations, that is to say, simple and fugitive perceptions when any object affects them, and perhaps also of experiencing inner emotions;

3. Lastly, those which have a brain together with its accessory hypocephalon enjoy the capacity for muscular movement, feeling, and emotion, and can moreover, by means of an essential condition (attention) form ideas, which are impressed on the organs, compare these ideas together, and produce judgments; and if their hemispheres are developed and perfected, they can think, reason, invent, and perform various intelligent acts.

No doubt it is very difficult to imagine how the impressions are formed that correspond to ideas; nothing whatever can be seen to

indicate their existence in the brain. But surely the only conclusion to be drawn from this, is the extreme fineness of the marks, and the limitations of our own faculties. Will any one say that nothing exists but what man can perceive? It is enough for us that memory is a certain testimony of the existence of these impressions in the brain.

If it is true that nature does nothing suddenly or at a single swoop, she must have created successively all the organs which give rise to the faculties observed in the most perfect animals; and this is just what she has done, with the help of time and favourable conditions.

This assuredly has been her procedure, and we cannot substitute any other for it unless we abandon the positive ideas that we derive from the observation of nature.

Thus in the animal organisation, the nervous system was created in its turn like the other special systems, and this can only have occurred when the organisation was sufficiently developed for the three sorts of substances composing this system to have been formed and deposited in their proper situations.

It is therefore absurd to expect to find this system with its dependent faculties in animals so simply organised and so imperfect as the infusorians and polyps; for it is impossible that such complex organs could exist in these creatures.

Let me repeat that just as the special organs in animals were formed one after the other, so too each of them was gradually compounded, completed and perfected in correspondence with the increasing complexity of organisation; so that the nervous system presents in different animals the three following principal stages.

At its origin, when it is in its highest imperfection, the system appears to consist merely of various separate ganglia, which have communicating threads and from which issue other threads to certain parts of the body: it then shows no brain and cannot give rise either to sight, hearing, or possibly any true sensation; but it already possesses the faculty of exciting muscular movement. Such apparently is the nervous system of the radiarians, if there is any truth in the observations cited in Part I. of this work (Chapter VIII., p. 138).

At its next stage, the nervous system presents a ganglionic longitudinal cord and nervous threads which terminate in the ganglia of that cord: henceforward the ganglion at the anterior extremity of the cord may be regarded as a rudimentary brain, since it gives rise to the organ of sight and subsequently to that of hearing; but this small brain is still simple and has no hypocephalon or wrinkled hemispheres with special functions. Such is the nervous system of insects, arachnids, and crustaceans,—animals which have eyes and in the latter case even

some traces of hearing : such again is the nervous system of annelids and cirripedes, some of which possess eyes, while others are destitute of them for the reasons named in Chapter VII. of Part I.

The molluscs, although having a higher organisation than the animals just mentioned, are in the midst of a change of plan on nature's part, and have no ganglionic longitudinal cord nor spinal cord ; but they have a brain and some of them seem to possess the most perfect of the simple brains, that is, of brains without a hypocephalon : since the nerves of several special senses terminate in them. If this is the case, then the nervous system produces muscular movement and feeling in all animals from the insects to the molluscs inclusive, but it does not permit of the formation of ideas.

Lastly, at a far more perfect stage, the nervous system of vertebrates presents a spinal cord, nerves and a brain, of which the superior and anterior part is provided with two accessory wrinkled hemispheres whose development is proportional to the stage of progress of the new plan. This system then gives rise not only to muscular movement, feeling and inner emotions, but also to the formation of ideas, the clearness and number of which are proportional to the development of the hemispheres.

How can any one suppose that nature, who in all her productions invariably proceeds by gradual stages, could have endowed a nervous system at once with all the faculties which it possesses when it has attained its ultimate completion and perfection ?

Moreover, since the faculty of feeling is not the property of any substance of the body, we shall see that the mechanism necessary for its production is so complex that the nervous system in its extreme simplicity could have had no other faculty than that of exciting muscular movement.

I shall endeavour to ascertain in Chapter IV. what is the power that causes and directs the emissions of nervous fluid to the hemispheres or other parts of the body. I shall merely say here that the dispatch of this fluid to the cerebral hemispheres arouses in them functions very different from those aroused in the muscles and vital organs.

I have now given a brief general account of the nervous system, the nature of its parts, the conditions that were required for its formation, and the four kinds of functions that it fulfils when it has attained its perfection.

Without undertaking any enquiry as to how nervous influence may set the muscles in action and cause the performance of their functions by various organs, I may observe that the explanation is probably to be found in a stimulus to the irritability of the parts.

But in the case of that function of the nervous system through which

feeling is produced and which is rightly regarded as the most astonishing and difficult to conceive, I shall endeavour to describe the mechanism in Chapter III. I shall then do the same for the fourth function of the nervous system by which it produces ideas, thoughts etc., a function still more extraordinary than that which gives rise to feeling.

Since, however, I do not wish to set forth in this work anything that is not based on adequate facts or observations, I shall first consider the nervous fluid, and show that, so far from being a product of imagination, this fluid is made manifest by effects which cannot be otherwise produced, and which leave not the slightest doubt as to its existence.

CHAPTER II.

OF THE NERVOUS FLUID.

A **SUBTLE** substance, remarkable for the rapidity of its movements and receiving little attention because it cannot be directly observed, collected, nor experimentally examined ; a substance of this character is the very strange and wonderful agent that nature employs for producing the muscular movement, feeling, inner emotions, ideas, and acts of intelligence, which many animals are able to carry out.

Now since we can only know this substance through the effects that it produces, we must begin by discussing it at the outset of the third part of this work ; this fluid is the only substance capable of causing the phenomena which so much excite our wonder ; and if we refuse to admit its existence and powers, we shall be forced to abandon all search for physical causes for these phenomena and to have recourse once more to vague and baseless theories for the satisfaction of our curiosity.

With regard to the necessity for investigating this fluid by means of its effects, is it not now an admitted fact that there exist in nature various kinds of substances, imperceptible to our senses, that we cannot take hold of, nor collect and examine as we should like ; substances so attenuated and so subtle that they can only manifest their existence under certain circumstances, and through the medium of some of their results, which we succeed by careful attention in identifying ; substances, in short, whose nature we can only ascertain up to a certain point by means of inductions and analogies, guided by a large number of observations ? The existence of these substances is however proved by certain effects which can be produced in no other way ; effects which we have to study carefully in various phenomena whose causes we seek.

It may be said by some that since we possess so few means for determining with precision the nature and qualities of these substances, every wise man who is concerned only with exact knowledge should leave them out of account.

I may be mistaken, but I confess that I am of quite a different opinion ; I am firmly convinced that these same substances play an important part in most of the physical facts that we observe, and especially in the organic phenomena presented by living bodies ; and hence that their investigation is of the greatest importance for the progress of knowledge on these subjects.

Thus, although we cannot know directly all the subtle substances existing in nature, yet if we were to abandon all enquiry with regard to some of them, we should in my opinion be rejecting the only clue that can lead to a knowledge of natural laws ; we should be giving up the hope of real progress in our knowledge of living bodies, as also of the causes of the phenomena that we observe in their functions ; we should at the same time be relinquishing the only path that can lead to the perfection of our physical and chemical theories.

It will soon be clear that these remarks are not irrelevant to my purpose, and indeed that they are entirely applicable to that nervous fluid about which we so greatly desire information.

Since our observations are now too advanced to permit of any real doubt as to the existence of a subtle fluid which circulates and moves about in the substance of the nerves, let us see how far we are led, on so delicate and difficult a subject, by the actual state of knowledge.

But before speaking of the nervous fluid, it is very important to establish the following proposition :

All the visible fluids contained in an animal's body, such as the blood or substitute for the blood, the lymph, secreted fluids, etc., move too slowly in the canals or parts which contain them, to be capable of conveying with sufficient rapidity the movement or cause of movement which produces actions in animals ; for these actions are carried out in many animals with an amazing rapidity and vivacity, and the animals can interrupt them, start them again, and vary them with all possible degrees of irregularity. The slightest reflection should suffice to convince us that it is absolutely impossible that fluids so gross as those just mentioned, and whose movements are usually so regular, can be the cause of the various actions of animals. Yet everything that passes in them results from relations between their contained fluids, or such as penetrate into them, and their containing parts, or the organs affected by these contained fluids.

Assuredly it can only be a fluid, moving almost with the swiftness of light, that could work such effects as those I have named ; now we have some knowledge of fluids which possess this faculty.

All action is the product of movement, and the nerves certainly act by a movement of some sort ; the opinion of those who regarded the nerves as vibrating cords has been discussed and effectually refuted

by M. Richerand in his *Physiologie* (vol. ii., p. 144 *et seq.*). "This hypothesis," he says, "is so absurd that there is reason for astonishment at the favour that it has long enjoyed."

The same thing might well be said of the hypothesis of vibration among molecules so soft and inelastic as those of the medullary substance of nerves, if anyone were to suggest it.

"It is much more reasonable," M. Richerand continues, "to believe that the nerves act by means of a subtle, invisible, impalpable fluid to which the ancients gave the name of *animal spirits*."

Farther on, when examining the special properties of the nervous fluid, this physiologist adds: "Have not these conjectures acquired some degree of probability, since the analogy between galvanism and electricity, originally suggested by their discoverer, has been confirmed by those remarkable experiments of Volta, which are at this moment being repeated, discussed and expounded by all the physicists in Europe?"

However manifest may be the existence of the subtle fluid by means of which the nerves work, there will be for a long time and perhaps for ever, men who dispute it because it cannot be proved except by effects which could not be produced in any other way.

Yet it seems to me that when all its effects unite to demonstrate its existence, it is wholly unreasonable to deny it on the mere grounds that we cannot see the fluids. It is particularly unreasonable to do so, seeing that we know that all organic phenomena result exclusively from relations between moving fluids and the organs concerned. It is still more unreasonable when we remember that the visible fluids (blood, lymph, etc.) which travel to the nerves and brain and penetrate their substance are too gross and move too slowly to be capable of giving rise to actions of such swiftness as those involved in muscular movement, feeling, ideas, thought, etc.

As a result of these reflections, I recognised that in every animal which possesses a nervous system there exists in the nerves and in the medullary nuclei where the nerves terminate, a very subtle, invisible, containable fluid, that is but little known since there are no means for examining it directly. This fluid, which I call nervous fluid, moves with extraordinary rapidity in the substance of the brain and nerves, and yet does not form any visible channels in them for the transmission of its movements.

It is by means of this subtle fluid that the nerves work, that muscular movement is set going, that feeling is produced, and that the cerebral hemispheres carry out those acts of intelligence to which they give rise in proportion to their development.

Although the actual nature of the nervous fluid is little known to us

since we can only appreciate it by its effects, yet since the discovery of galvanism, it has become increasingly probable that it is closely analogous to the electric fluid. I am convinced even that it is electric fluid, which has been modified in the animal economy and to some extent animalised by its residence in the blood, and which has there undergone sufficient change to have become containable and to remain entirely within the medullary substance of the nerves and brain, to which it is incessantly provided by the blood.

I base this statement, viz. that the nervous fluid is only electricity modified by its residence in the animal economy, on the fact that this nervous fluid, although its effects closely resemble some of those produced by the electric fluid, is yet distinguished from it by some peculiar properties, among which that of being retained within an organ and moving about there, sometimes in one direction and sometimes in another, appears to be characteristic.

The nervous fluid is therefore quite distinct from the ordinary electric fluid, since the latter passes through every part of our body at its usual velocity and without any pause, when we complete a circuit in the discharge of a Leyden jar or electric conductor.

It is different even from the galvanic fluid obtained from Volta's pile: the latter indeed, which is still only electric fluid acting in a smaller quantity, density and activity than the electric fluid of a Leyden jar or charged conductor, derives from its special circumstances certain properties or faculties which distinguish it from the electric fluid collected and condensed by our ordinary methods. This galvanic fluid therefore has more action on our nerves and muscles than the ordinary electric fluid: yet since it is not animalised, that is to say, has not undergone the influence imparted by a residence in the blood (especially of warm-blooded animals), it does not possess all the qualities of the nervous fluid.

The nervous fluid of cold-blooded animals, being less animalised, is more allied to the ordinary electric fluid and especially the galvanic fluid. This is the reason why our galvanic experiments produce very energetic effects on the tissues of cold-blooded animals like frogs; and also why in certain fishes such as the torpedo, the electric eel, and the trembling catfish, a large electrical organ generates electricity which is completely adapted to the animal's needs. (See the interesting Memoir of M. Geoffroy on these fishes in the *Annales du Muséum d'Histoire naturelle*, vol. i., p. 392.)

In spite of the modifications by which the electric fluid is converted into nervous fluid, it still preserves to a great extent its extreme subtlety and rapidity of movement; qualities which render it suitable for performing its functions in the animal.

This electric fluid is incessantly penetrating into the blood, either by respiration or some other method, and is there gradually modified and animalised so as to acquire at length the properties of the nervous fluid. Now we may probably regard the ganglia, spinal cord, and especially the brain with its accessories, as the organs which secrete this animal fluid.

There is indeed reason to believe that the substance of the nerves, which, on account of its albumino-gelatinous nature, is a better conductor of the nervous fluid than any other substance of the body, and far better than the aponeurotic membranes which invest the nervous threads and cords, continually draws off the subtle fluid in question from the minute arteries circulating in it. It is no doubt these minute arteries and veins that give rise to the grey colour of the external or cortical layer of the medullary substance.

In this way, there is incessantly produced in animals with a nervous system the subtle and invisible fluid which moves in the substance of their nerves and in the medullary nuclei where these nerves terminate.

This fluid works in the nerves by two kinds of movements in opposite directions; and the activities of the cerebral hemispheres suggest that it carries out many and varied movements in them that are beyond our powers of ascertaining.

In the nerves which give rise to sensations, we know that the fluid moves from the periphery of the body towards the centre, or rather towards the nucleus that produces these sensations; and since the individuals which have a nervous system may also experience internal impressions, the fluid in these cases moves in the nerves of the internal regions, but still in the direction of the nucleus of sensations.

In the nerves which produce muscular movement, on the contrary, whether voluntary or involuntary, the nervous fluid moves from the centre or common nucleus towards the parts which have to be moved.

In both these cases where the nervous fluid moves in the nerves, and also in the case of its various movements in the brain, the activity of this fluid consumes a certain part of it, which is thereby dissipated and lost. This loss necessitates a restoration, which is continually being made by healthy blood.

The following is a very important observation for understanding the phenomena of organisation:

Individuals, which use their nervous fluid only for the production of muscular movement, make good their losses with interest, so that their strength is increased; since this muscular movement accelerates the circulation and other organic movements, and the secretions which make up for the used fluid are copious at the periods of rest.

Individuals, on the other hand, who use their nervous fluid only in

the production of acts depending on the hypocephalon, such as continuous thought, deep meditation, mental agitation produced by passions, etc., make good their losses slowly and often incompletely; for muscular movement is then slight, the organic movements are enfeebled, the organic faculties lose their energy, and the secretions, which make up for the nervous fluid used, become less copious, and mental repose very difficult.

The nervous fluid in the brain does not merely convey sensations from their nucleus, and move about in various ways, but it also stamps impressions on the organs, and these impressions last longer or shorter according to their depth.

This statement is not one of those monstrous products begotten by the imagination: in a brief review of the chief acts of intelligence, I shall endeavour to show that it is well-founded, and that we are obliged to recognise it as one of those truths, that can still only be attained by irrefutable inductions.

I shall conclude my remarks on this singular fluid by some observations which may throw much light over the various organic functions fulfilled by means of this fluid.

All parts of the nervous fluid are in communication, in the system of organs which contains them; so that, according to the causes which excite it, either a part of the fluid may be set in motion, or nearly the whole fluid, or at least such part of it as is free.

The occasions when motion occurs only in parts of it, which may even be quite small, are as follows:

1. When it stimulates muscular activity, either dependent or independent of the will of the individual;
2. When it performs some act of intelligence.

The same fluid, on the contrary, moves as a whole (so far as it is free):

1. When it produces any sensation by some general movement of reaction;
2. Whenever it causes emotions of the inner feeling by a general agitation that does not constitute a reaction.

These details as to the movements of the nervous fluid cannot be proved by individual experiments; at least I do not see how; but the reader will probably think them justified, if he closely follows my observations on the functions of the nervous system in this third part of my *Zoological Philosophy*. In particular, the following facts should be considered:

1. That the nervous influence which moves the muscles only demands a simple emission of a part of the nervous fluid towards the muscles which have to act, and that the fluid here acts only as a stimulus;

2. That, in acts of intelligence, the organ of understanding is only passive and is prevented from reacting by its extreme softness ; it acquires no activity from the nervous fluid but merely impressions, of which it preserves the tracings ; the part of the fluid, which works in the various portions of this organ, is modified in its movements by the tracings already present, and at the same time traces more ; so that the organ of understanding, which has only a narrow channel of communication with the rest of the nervous system, uses only a part of the whole fluid of the system. Moreover this narrow channel of communication preserves that part of the nervous fluid, contained in the organ of intelligence, from the general agitation which occurs in emotions of the inner feeling, and in the formation of sensations, except when that agitation is of great intensity, in which case nearly all the functions and faculties of the system are disturbed.

On these grounds, it appears probable that the entire mass of nervous fluid secreted and contained in the system is not at the disposal of the inner feeling of the individual, but that some of it is held in reserve to provide for the continuance of the vital functions. Hence, just as there are muscles independent of the will, and others which only enter into activity when excited by the inner feeling driven by the will or some other cause ; in the same way, no doubt, one part of the nervous fluid is less at the service of the individual than the other, lest the whole fluid should be drained away from the vital functions.

Indeed, since the nervous fluid is never used without a proportional amount of loss, it follows necessarily that the individual is only free to use up a certain part of it : untoward effects ensue even when this part is run too low, for then some of that held in reserve becomes available and the vital functions suffer accordingly.

I shall have further opportunities later on for extending these various remarks on the nervous fluid ; but let us first enquire what is the mechanism of sensations, and how the marvellous faculty of feeling is produced.

CHAPTER III.

OF PHYSICAL SENSIBILITY AND THE MECHANISM OF SENSATIONS.

How are we to conceive that certain parts of a living body can possess the faculty of feeling, when no kind of matter whatever does or can enjoy any such faculty !

It was indeed a great mistake to imagine that animals, even the most perfect, were endowed with feeling in certain of their parts. Assuredly the various humours and fluids of living bodies can no more possess the faculty of feeling than the solid parts.

It is only by a real hallucination that the separate parts of our body appear to be sensitive ; for it is our entire being that feels or rather undergoes a general effect, on the stimulus of some affective cause. Since this effect is always referred to the part affected, we promptly derive from it a perception to which we give the name of sensation ; and we are misled into the belief that it is the affected part of our body that feels an impression, whereas it is a commotion throughout the entire sensitive system which conveys to that part its general effect.

These considerations may appear strange and even paradoxical, for they are far removed from the common opinion on this subject. Yet if the reader will suspend his judgment until he has examined the grounds on which I base my opinion, he will doubtless abandon the idea of attributing the faculty of feeling to any individual part of a living body. But before stating my views, it must first be determined what animals possess the faculty of feeling and what animals have no such faculty.

Let me first enunciate the following principle : Every faculty possessed by animals is necessarily the product of an organic act and consequently of some movement ; if the faculty is special, it results from the function of some special organ or system of organs ; but no part of the animal body that remains motionless could possibly give rise to any organic

phenomenon, not even to the smallest faculty. Hence feeling, which is a faculty, is not a property of any individual part, but the result of an organic function.

I infer from the above principle that every faculty, that arises exclusively from the functions of some especial organ, is confined to animals which possess that organ. Thus just as no animal can see unless it has eyes, so no animal can feel unless it has a nervous system.

It is useless to object that light does make impressions on certain living bodies that have no eyes, and affects them in spite of that deficiency : it still remains true that plants and a number of animals, such as polyps and many others, do not see although they move towards the light ; and that all animals are not endowed with feeling, although they may perform movements when irritated in special ways.

No sort of sensibility (conscious or latent) can, then, be ascribed to animals that have no nervous system, on the mere grounds that they have irritable parts ; I have already shown in Part II., Chapter IV., that feeling and irritability are very different in character, and are due to quite unlike causes. Indeed the conditions required for the production of feeling are of altogether another nature from those necessary for the presence of irritability. The former demand a special organ which is always distinct, complex, and extended throughout the animal's body, whereas the latter demand no special organ and give rise only to an isolated and local phenomenon.

But animals, which possess a sufficiently developed nervous system, possess at the same time their natural irritability and also the faculty of feeling ; they have, without being conscious of it, the intimate feeling of their existence, and though they are still liable to excitations from without, they act by an internal power that we shall shortly examine.

In some, the activities of this internal power are guided by instinct, that is, by inner emotions produced by their needs and habits ; while in others they are guided by a will that is more or less free.

Thus the faculty of feeling is exclusively the property of animals which have a *sensitive* nervous system ; and since it gives rise to the intimate feeling of existence, we shall see that this latter feeling endows animals with the faculty of acting by emotions which cause them internal excitations, and permit them to produce for themselves the movements and actions necessary for the satisfaction of their needs.

But what is physical sensibility or the faculty of feeling ? What again is the inner feeling of existence ? What are the causes of these

wonderful phenomena ? Lastly, how can the feeling of existence or general inner feeling give rise to a force that produces action ?

I have conscientiously considered these matters and the wonders that flow from them, and now state my opinion on the first of these interesting questions.

The faculty of receiving sensations constitutes what I call *physical sensibility*, or feeling properly so called. This sensibility must be distinguished from *moral sensibility* which is quite a different thing, as I shall show, and which is only excited by emotions raised in us by our thoughts.

Sensations arise in us, on the one hand, from the impressions that external objects make on our senses ; and, on the other hand, from those made on our organs by disordered internal movements which have an injurious effect and produce internal pains. Now these sensations affect our physical sensibility or faculty of feeling, bring us into communication with the outer world, and acquaint us vaguely with what is happening within us.

Let us now enquire into the mechanism of sensations, and let us begin by showing the harmony which exists in all the parts concerned of the nervous system, and afterwards the result on the entire system of any impression on a single part of it.

MECHANISM OF SENSATIONS.

Sensations, which by an illusion we refer to the actual places where the impressions that cause them are made, are based upon a system of special organs belonging to the nervous system and called the *system of sensations* or of sensibility.

The system of sensations is composed of two essential and distinct parts, viz. :

1. A special nucleus, that I call the nucleus of sensations, and must be regarded as a centre of communication to which are conveyed all the impressions which act upon us ;
2. A large number of simple nerves which start from all the sensitive parts of the body and proceed to their destination in the nucleus of sensations.

It is with this system of organs, whose harmony is such that all or nearly all parts of the body share equally in an impression made on any one part, that nature succeeds in giving, to all animals with a nervous system, the faculty of feeling both what affects them internally and also impressions made upon their senses by external objects.

It may be that the nucleus of sensations is broken up and multiple in animals which have a ganglionic longitudinal cord ; yet we may suspect that the ganglion at the anterior extremity of the cord is a

small rudimentary brain, since it gives rise immediately to the sense of sight. But in the case of animals which have a spinal cord, there can be no doubt that the nucleus of sensations is simple and indivisible; this nucleus is apparently situated at the anterior extremity of the spinal cord, at the base of what is called the brain and therefore below the hemispheres.

The sensitive nerves arriving from all parts and terminating in a centre of communication, or in several such nuclei connected together, constitute the harmony of the system of sensations, for they spread throughout the system all the impressions, whether isolated or generalised, that the individual may experience.

To form a clear conception of the wonderful mechanism of this sensitive system, we must recall what I said before, viz. that an extremely subtle fluid, whose movements of translation or oscillation are nearly as rapid as light, is contained in the nerves and their nucleus, where it moves freely without escaping.

If we now consider that harmony which unites all parts of the system of sensations, we see that every impression, internal or external, that any individual receives, immediately causes an agitation throughout the system or the subtle fluid contained in it, and consequently throughout the entire body, although it may pass unperceived. Now this sudden agitation promptly gives rise to a reaction, which is brought back from all parts to the common nucleus, and there sets up a singular effect, in short, an agitation, which is thereafter propagated through the one nerve, that does not react, to the point of the body that was originally affected.

Man, who possesses the faculty of forming ideas out of what he experiences, has formed one out of this singular effect produced at the nucleus of sensations and propagated to the point affected, and has given it the name of sensation, in the belief that every part that receives an impression possesses in itself the faculty of feeling. Feeling, however, does not exist anywhere but in the actual idea or perception which constitutes it, since it is not a faculty belonging to any part of our body nor any of our nerves, nor even to the nucleus of sensations, but is purely the result of an emotion of the whole sensitive system which becomes perceptible in some point of our body. Let us examine in further detail the mechanism of this singular effect of the system of sensibility.

In the case of animals which have a spinal cord, there start from every part of their body, the most deeply situated as well as the most superficial, nervous threads of extreme fineness, which without any division or anastomosis proceed to the nucleus of sensations. Now these threads, in spite of junctions which they form with others,

travel without any discontinuity to their nucleus, always retaining their individual sheaths. This does not prevent the nervous cords, which arise from the junctions of several such threads, from having their own sheath as well; and the same applies to the still larger cords formed by the union of several of these.

Each nervous thread may thus be distinguished by the name of the part where it starts, for it only transmits impressions made on that part.

We are here dealing exclusively with nerves serving for sensations: those destined for muscular movement start apparently from some other nucleus, and constitute a special system within the nervous system, distinct from that of sensations; in the same way that the latter is distinct from the system providing for the formation of ideas and acts of the understanding.

It is true that in consequence of the close connection between the system of sensations and that of muscular movement, paralysis usually extinguishes both feeling and movement in the parts affected; nevertheless cases are seen where sensibility is quite extinct in certain parts of the body which still possess freedom of movement,¹ and this proves that the systems of sensation and movement are really distinct.

The special mechanism which constitutes the organic act giving rise to feeling, consists therefore in the following process:

When an impression is received at the extremity of a nerve, the movement thereupon set up in the subtle fluid of that nerve is transmitted to the nucleus of sensations, and from there to all the nerves of the sensitive system. But the nervous fluid immediately reacts from all the nerves together, and brings back this general movement to the common nucleus, where the only nerve which brought no reaction receives the entire product of all the rest and transmits it to the point of the body originally affected.

For greater clearness let us take a special example of the details of this mechanism.

¹ M. Hébréard records in the *Journal de Médecine, de Chirurgie et de Pharmacie* that a man fifty years of age had suffered, ever since he was fourteen, from an absolute insensibility in the right arm. Yet this limb retained its activity, size and usual strength. A phlegmon grew upon it, causing heat, swelling and redness, but no pain even when squeezed or pressed.

While working, this man fractured the bones of his fore-arm in their lower third. At first he only heard a crack, and thought that he had broken the spade which he held in his hand; but it was intact, and he only discovered his accident, because he could not continue his work. The next day the site of the fracture had swollen, and the temperature of the fore-arm and hand had risen: yet the patient experienced no pain even during the extensions necessary for reducing the fracture, etc.

The author concludes from this fact and from similar experiences by other doctors, that sensibility is absolutely distinct and independent from contractility, etc., etc. (*Journal de Médecine pratique*, 15th June, 1808, p. 540).

If I am pricked in the little finger of one of my hands, the nerve of the part affected runs in its special sheath and without communication with others to the common nucleus, where it delivers the agitation it has received; this agitation is immediately propagated thence to the fluid in all the other nerves of the sensitive system: then by a true reaction or repercussion this agitation flows back from all points to the common nucleus, where it produces a shock and a compression of the agitated fluid on all sides save one. This total effect produces a perception, the result of which is carried back by the single nerve which did not react.

In point of fact, the nerve which brought in the original impression, and thus set up the agitation of fluid in all the rest, is the only one which gives no reaction; for it is the only one that is active while all the rest were passive. The whole effect of the shock produced in the common nucleus and passive nerves, as also the resulting perception, must therefore be carried off by this active nerve.

An effect of this kind resulting from a general movement throughout the individual, necessarily advertises him of an event passing within; and this individual, though he cannot make out any details, derives from it a perception to which he gives the name of sensation.

The strength of this sensation is presumably proportional to the intensity of the impression, and its character would correspond with the actual nature of the impression received; it appears to be produced in the very part affected, simply because the nerve of that part is the only one affected by the general disturbance that is set up.

Thus every shock produced in the nucleus or centre of communication of the nerves, due to an impression received, is felt throughout the body though always appearing to us to take place in the very part which received the impression.

With regard to this impression, there is necessarily an interval between the moment at which it is made and that when sensation is produced, but this interval is so short, on account of the rapidity of the movements, that it is impossible for us to perceive it.

Such, in my opinion, is the wonderful mechanism underlying physical sensibility. Let me repeat that it is not matter that feels, for matter has no such faculty; it is not even a part of the individual's body, for the sensation experienced in any such part is only an illusion, as many facts combine to prove; but it is a general effect, produced throughout the body, which is entirely concentrated on the same nerve that first caused it, and which is necessarily felt by the individual at the extremity of that nerve where the impression was made.

All that we perceive is within ourselves: this is now a well-established truth. For a sensation to arise, it is absolutely necessary that

the impression received by the part affected should be transmitted to the nucleus of the system of sensations; but if the whole action ended there, there would be no general effect, and no reaction would be conveyed to the point which received the impression. As regards the transmission of the original movement impressed, it doubtless only takes place through the nerve which was affected and by means of the nervous fluid moving in its substance. We know that, if by a ligature or tight compression of the nerve, we intercept communication between the portion arriving from the part affected and that passing on to the nucleus of sensations, no transmission of movement is effected.

The ligature or tight compression interrupts the continuity of the soft substance of the nerve by binding together the walls of its sheath, and thus suffices to intercept the passage of the nervous fluid; but, as soon as the ligature is removed, the elasticity of the nervous substance permits of restoration of continuity in the nerve, and sensation can then be produced again.

Although therefore it is true that we only feel what is within ourselves, yet the perception of the objects which affect us does not occur, as has been held, in the nucleus of sensations, but at the extremity of the nerve which received the impression; and all sensation is thus actually felt in the part affected, because it is there that the nerve of this part terminates.

But if this part no longer exists, the nerve, which ran there, continues to exist although it is shortened; if therefore this nerve receives an impression a sensation is experienced which appears by illusion to be in the part that is no longer possessed.

It has been observed that people who have lost a leg, feel, when the stump has healed, at changes of the weather, pains in the foot or leg which they no longer possess. It is obvious that in these individuals there is an error of judgment as to the actual site of their sensation; but this error is due to the fact that the nerves affected were just those which were originally distributed in the foot or leg of these individuals; in reality the sensation is produced at the extremity of the shortened nerve.

The nucleus of sensations only serves for the production of the general disturbance set up by the nerve which received the impression, and for bringing back into this nerve the reaction from all the rest; hence there results at the end of the affected nerve an effect, which all parts of the body combine to produce.

Cabanis seems to have had some notion of the mechanism of sensations, for although he did not work out the principles of it clearly, and although he wrongly suggests a mechanism analogous to that by which

the nerves excite muscular action, yet he obviously had a general idea of what actually occurs in the production of sensations; he expresses himself as follows:

“The operations of sensibility may be regarded as being made up of two phases. In the first place the extremities of the nerves receive and transmit the original impression either to the entire sensitive organ, or, as we shall see later, to one of its isolated systems; the sensitive organ then reacts on the nerve endings, so that the sensibility, which in the first phase seems to have travelled from the periphery to the centre, returns in the second phase from the centre to the periphery; and the nerves, to put it briefly, exert a real reaction on themselves for producing feeling, just as they do on the muscular parts for producing movement.” (*Rapports du Physique et du Moral*, vol. i., p. 143.)

The only deficiency in the above statement is the omission to state that the nerve at whose extremity the original impression was received is the only one which does not subsequently react; and that for this reason the general reaction from the other nerves of the system, on reaching the common nucleus, is necessarily transmitted into the only nerve that is at the moment in a passive state, and thus conveys to the point first affected the general effect of the system, that is to say, sensation.

As to the statement of Cabanis that the nerves exert a similar reaction on the muscular parts for setting them in motion, I believe that this comparison between two very different acts of the nervous system has no true foundation; but that a simple emission of the fluid of the nerves from its reservoir to the muscles is a sufficient explanation: there is no necessity to assume any nervous reaction.

I shall conclude my observations on the physical causes of feeling by the following reflections, for the purpose of showing that it is a mistake to confuse the perception of an object with the idea that may be called up by the sensation of that object, and also to imagine that every sensation necessarily yields an idea.

To experience a sensation and to distinguish it are two very different things: the former without the latter constitutes only a simple perception; whereas the latter, which is never found apart from the former, alone gives rise to the idea.

When we feel a sensation from some external object and distinguish that sensation, although we only feel what is within ourselves and although we have to make one or more comparisons in order to differentiate the object from our own existence and form an idea of it, we carry out almost simultaneously by means of our organs two acts of essentially different kinds, one of which makes us feel while the other

makes us think. We shall never succeed in disentangling the causes of these organic phenomena, so long as we confuse the entirely distinct facts which constitute them, and fail to recognise that they cannot both have a common origin.

A special system of organs is certainly needed for producing the phenomenon of feeling, since this is a faculty peculiar to certain animals and not general for all. So too a special system of organs is necessary for carrying out acts of the understanding; for thought, comparison, judgment, reasoning are organic acts of a very different character from those producing feeling. Hence, when we think, we do not feel any sensation, although our thoughts impress the inner feeling or ego of which we are conscious. Now since all sensation arises from a special sense, it follows that the consciousness of one's thoughts is not a sensation, but differs radically from it, and must be kept distinct. In the same way, when we feel a simple sensation that constitutes perception, and thus passes unnoticed, no idea of it is formed and no thought produced, so that the sensitive system alone is in action. We may therefore think without feeling, and feel without thinking. Hence for each of these two faculties there is a separate system of organs; just as there is a separate system for movements which is independent of the other two, although one or other of them is the remote cause which sets the latter in action.

Thus it is wrong to confuse the system of sensations with the system that produces acts of the understanding, and to imagine that the two kinds of organic phenomena arising from them can be the result of a single system of organs. This is why men of the highest capacity and knowledge have been mistaken in their arguments on subjects of this nature.

“A creature,” says M. Richerand, “absolutely destitute of sensitive organs would have a purely vegetative existence; if it acquired one sense it still would not possess any understanding, since, as Condillac has shown, the impressions produced on this single sense could not be compared; it would have nothing more than an inner feeling of its existence, and it would believe that all things which affect it are part of itself.” (*Physiologie*, vol. ii., p. 154.)

We see from this quotation that the senses are considered, not merely as sensitive organs, but also as organs of the understanding; since, if instead of a single sense the creature had several, then according to the received opinion the mere existence of these senses would endow it with intellectual faculties.

There is even a contradiction in the passage above cited; for it is there stated that a creature which had only one sense would still not possess understanding, and farther on it is said, with reference to the

impressions which it would experience, that the whole effect would be limited to an inner feeling of its existence, and it would believe that all things which affect it are part of itself. How can this being think or form judgments, if it possesses no understanding? For to believe anything is to form a judgment.

As long as we fail to distinguish the facts connected with feeling from those connected with intelligence, we shall often make mistakes of this character. It is an established fact that there are no innate ideas, but that every simple idea arises exclusively from a sensation. But I hope to show that not every sensation produces an idea; indeed that it need cause no more than a perception, and that for the production and impression of a permanent idea a special organ is needed, as well as compliance with a certain condition not involved in the organ of sensations.

It is a long way from a simple perception to an impressed and permanent idea. Indeed no sensation, which causes only a simple perception, makes any impression on the organ; it does not need the essential condition of *attention*, and can do no more than excite the inner feeling of the individual and give it momentary perceptions of objects, without the production of any thought. Moreover memory, whose seat can only be in the organ where ideas are traced, can never bring back a perception which did not penetrate to this organ, and therefore left no impression on it.

I regard perceptions as imperfect ideas, always simple, not graven on the organ and needing no condition for their occurrence; and this is a very different state of affairs from what prevails in the case of true and lasting ideas. Now these perceptions, by means of habitual repetitions which cut out certain channels for the nervous fluid, may give rise to actions which resemble those of memory. Examples are furnished us by the manners and habits of insects.

I shall hereafter revert to this subject; all that I had here to remark was the necessity of distinguishing perception, which results from every unnoticed sensation, from an idea, which, as I hope to show, requires a special organ for its formation.

From the foregoing principles I think we may conclude:

1. That the phenomenon of feeling is not more miraculous than any other phenomenon in nature, that is, any phenomenon produced by physical causes;
2. That it is not true that any part of a living body, or any substance composing it, has in itself the faculty of feeling;
3. That feeling is the result of an action and reaction, which become general throughout the nervous system, and are performed with rapidity by a very simple mechanism;

4. That the general effect of this action and reaction is necessarily felt by the individual's indivisible ego, and not by any separate part of his body; so that it is only by illusion that he thinks that the effect is entirely wrought at the point where the impression was received;

5. That whenever an individual notices a sensation, identifies it, and distinguishes the point of its body on which it takes effect, the individual then has an idea, thinks, carries out an act of intelligence, and must therefore possess the special organ for producing it;

6. Lastly, that, where the system of sensations exists without the system of understanding, the individual performs no act of intelligence, has no ideas, and only derives from its senses simple perceptions which it does not notice, although they may arouse its inner feeling and make it act.

Let us now endeavour if possible to form a clear idea of the emotions of the inner feeling of any individual possessing physical sensibility, and to ascertain what power this individual gains from it, for carrying out its actions.

CHAPTER IV.

OF THE INNER FEELING, THE EMOTIONS THAT IT MAY EXPERIENCE, AND THE POWER WHICH IT THENCE DERIVES FOR THE PRODUCTION OF ACTIONS.

My purpose in the present chapter is to treat of one of the most remarkable faculties conferred by the nervous system on all animals in which it is highly developed ; I mean that singular faculty, with which certain animals and man himself are endowed, consisting in the capacity to experience inner emotions called forth by the needs and various causes external or internal ; from this faculty arises the power for performing diverse actions.

Nobody, so far as I know, has yet considered the interesting subject with which I am about to deal ; yet, unless we fix our attention on this subject, we shall never be able to account for the numerous phenomena presented by animal organisation, which have their origin in the aforementioned faculty.

We have seen that the nervous system consists of various organs which are all in communication with one another ; consequently every part of the subtle fluid contained within this system is in communication with every other part, and is therefore liable to undergo a general agitation in the presence of certain causes adapted for exciting it. We have here an essential principle that we must keep in mind throughout our enquiries ; its accuracy cannot be questioned since proofs of it are furnished by the observed facts.

Yet the whole of the nervous fluid is not always sufficiently free to take part in the agitation under consideration, for in ordinary cases it is only one portion of the fluid (no doubt a large portion) that is capable of undergoing this agitation when aroused by certain emotions.

It is certain that in various circumstances, the nervous fluid undergoes movements in more or less isolated parts of its mass : portions of this fluid are thus dispatched to the various parts for muscular action, and for the vivification of organs, without the whole fluid being set in

motion ; in the same way portions of a fluid may be agitated in the cerebral hemispheres, while the rest of the fluid remains still : these are truths that cannot be called in doubt. But if it is manifest that the nervous fluid may receive movements in a certain part of its mass, it is no less so that special causes may agitate almost the entire mass of this fluid, since all its parts are in communication. I say *almost* the entire mass, because in the ordinary inner emotions, that portion of the nervous fluid which serves for the excitation of muscles independently of the individual, and often also that portion contained in the hemispheres of the brain, are sheltered from the agitations which constitute emotions.

The nervous fluid may therefore undergo movement in its separate parts, or as a whole ; it is these latter movements which constitute the general agitations of the fluid, that we are about to discuss.

General agitations of the nervous fluids are of two kinds, viz. :

1. Partial agitations which become general and end by reactions ; it is this kind of agitation which produces feeling. We have dealt with it in Chapter III. ;

2. Agitations which are general from the first and form no reaction : it is these which constitute the inner emotions, and it is exclusively with them that we shall now deal.

But a word must first be said about the feeling of existence, since it is in this feeling that the inner emotions take their rise.

OF THE FEELING OF EXISTENCE.

The feeling of existence, which I shall call *inner feeling*, so as not to imply a universality which it does not possess, is a very obscure feeling possessed by animals whose nervous system is sufficiently developed.

This feeling, obscure as it is, is none the less very powerful ; for it is the origin of the inner emotions, and consequently of that singular force which enables individuals to produce for themselves the movements and actions which their needs demand. Now this feeling, regarded as a very active motive power, works simply by dispatching to the required muscles the nervous fluid which is to excite them.

The feeling in question is now well recognised, and results from the confused assembly of inner sensations which are constantly arising throughout the animal's life, owing to the continual impressions which the movements of life cause on its sensitive internal parts.

Indeed, as a result of the organic or vital movements taking place in every animal, those which possess an adequate nervous system derive from it physical sensibility and are incessantly being affected

by impressions throughout their sensitive internal parts ; the animal feels these all confused together, without being able to distinguish any one.

As a matter of fact, all these impressions are very weak ; and although they vary in intensity according to the health of the individual, they are usually very difficult to distinguish, because they are not liable to any sudden interruption or renewal. Yet the sum-total of these impressions, and the confused sensations resulting from them, constitute in all animals subject to them a very obscure but real inner feeling that has been called the feeling of existence.

This continuous and intimate feeling, which is not appreciated because it is not noticed, is general, in that all the sensitive parts of the body share in it. It constitutes that ego with which all animals that are merely sensitive are imbued without knowing it, while those which also possess an organ of intelligence may notice it, since they have the faculties of thought and attention. Finally, it is in both cases the source of a power, which the needs can evoke, which only acts effectively by emotion, and from which movements and actions derive their motive force.

The inner feeling may be considered under two quite different aspects viz. :

1. In so far as it is the result of obscure sensations which continue without cessation in all sensitive parts of the body : from this aspect I call it simply inner feeling ;

2. In its faculties : for the general agitations of the subtle fluid confer upon animals the power of producing movements and actions for themselves.

This feeling, which forms a very simple whole, is susceptible of being stirred by various causes. When it is aroused, it can excite movements in the free portions of the nervous fluid, direct those movements, and convey the stimulating fluid to one or another muscle or to any part of the cerebral hemisphere ; it then becomes a power for exciting action or thought. From this second aspect therefore we may regard the inner feeling as the fountain from which the force that produces actions derives its energy.

It is necessary for a comprehension of the phenomena produced, to examine this feeling from the two aspects named above ; for by its very nature as a feeling of existence it is always in action throughout the waking period ; and by its faculties it gives rise to a force which causes action.

Finally, the inner feeling only manifests its power and produces actions when there exists a system for muscular movement : this system is always dependent on the nervous system and cannot exist without it.

It would therefore be inconsistent to look for muscles in animals which obviously had no nervous system.

Let us now turn to a discussion of the chief facts about the emotions of the inner feeling.

OF THE EMOTIONS OF THE INNER FEELING.

We now have to investigate one of the most important phenomena of animal organisation, viz. those emotions of the inner feeling which lead to action in animals and even in man, sometimes without any effort of their will ; emotions long ago recognised, but as to the origin or causes of which no one seems to have paid any attention.

Observation leaves no room to doubt that the general inner feeling experienced by animals which possess the requisite nervous system, is susceptible of being stirred by causes which affect it ; now these causes always consist in the need either of assuaging hunger or of flying from danger, or avoiding pain, or seeking pleasure, or what is agreeable to the individual, etc.

The emotions of the inner feeling can only be known by man, since he alone can notice and mark them ; but he only perceives those which are strong, and which agitate, so to speak, his whole being ; close attention and thought is necessary before he can recognise that he experiences them in all degrees of intensity, and that it is exclusively the inner feeling that under various circumstances stirs up in him those inward emotions which lead him to the execution of some action.

I have already said, at the beginning of this chapter, that the inner emotions of a sensitive animal consist in certain general agitations of all the free parts of the nervous fluid, and that since the agitations are followed by no reactions they produce no distinct sensation. Now we may easily imagine that, when these emotions are weak or moderate, the individual may dominate them and control their movements ; but that when they are sudden and powerful he is then mastered by them : this is a very important consideration.

The positive fact of the existence of these emotions is no mere hypothesis. Who has not noticed that a loud and unexpected noise makes us start or give a sort of jump, and execute corresponding movements that our will had not determined ?

Some time ago I was walking in the street with my left eye covered by my pocket-handkerchief, because it was in pain and irritated by the sunlight. A horse and rider that I did not see suddenly fell, quite close to me on my left : I instantly found myself transported two steps towards the right by a movement or bound, in which my will had not the smallest share, and before I had any idea of what was happening close to me.

Everybody is acquainted with these kinds of involuntary movements, for everybody has experienced the like; and they are only noticed because they are extreme and sudden. But we pay no attention to the fact that everything, which affects us, stirs our emotions proportionally, that is to say, stirs to some extent our inner feeling.

We are moved by the sight of a precipice, of a tragic scene, either real or on the stage or even on a picture, etc., etc.: and where is the power of a fine piece of music well executed, if not in producing emotions of our inner feeling? Consider again the joy or sorrow that we suddenly feel on hearing good or bad news about something that interests us: what is it but the emotion of that inner feeling, which is very difficult to master on the spot?

I have several times seen pieces of music played on the piano by a young lady who was deaf and dumb: her playing was far from brilliant and yet it was passable; she kept good time, and I perceived that her entire personality was stirred by regular movements of her inner feeling.

I gathered from this that the inner feeling in this young person took the place of the organ of hearing, which was of no use. Her music-master too told me that he had practised her in keeping time by measured signs, and I soon became convinced that these signs had stirred within her the feeling in question; hence I inferred that what we attribute entirely to the highly trained and delicate ears of good musicians belongs rather to their inner feeling, which from the first bar is stirred by the kind of movement necessary for the performance of a piece.

Our habits, temperament, and even education, modify this faculty of undergoing emotion; so that in some individuals it is very weak while in others it is very strong.

A distinction should be drawn between the emotions aroused by the sensation of external objects and those which come from ideas, thoughts, or acts of our intellect; the former constitute *physical* sensibility, whereas the latter characterise the *moral* sensibility, that we shall now turn to consider.

MORAL SENSIBILITY.

Moral sensibility is very different from the physical sensibility that I have already mentioned; the former is only excited by ideas and thoughts which move our inner feeling, while the latter only arises from impressions produced on our senses; for these can likewise stir our inner feeling.

The seat of moral sensibility has been wrongly supposed to be in the heart, on the ground that the functions of that viscus are more or less

affected by the different manifestations of sensibility. But in reality moral sensibility is nothing more than a very delicate susceptibility to emotion, which is aroused in the inner feeling of certain individuals on the sudden presentation of suitable ideas and thoughts. These individuals are then said to be highly sensitive.

This sensibility, when developed to the extent attainable to a perfected intellect, appears to me a product and even a benefaction of nature. It then forms one of the finest qualities of man, for it is the source of humanity, kindness, friendship, honour, etc. Sometimes, however, circumstances make this quality almost as baneful to ourselves as its presence in others is beneficial: in order to derive from it the benefits without the disadvantages, we simply have to moderate its transports by methods which nothing but a good education can indicate.

A good education shows us the necessity on innumerable occasions for repressing our sensibility up to a certain point, in order not to fall short in the respect which man in society owes to his fellows, as also to the age, sex, and rank of those with whom he consorts: hence result that decorum and amenity in the expressions used in conversation, in short, that careful restraint in the expression of ideas which gives pleasure without ever wounding, and confers a quality of high distinction to those that possess it.

Up to this point our conquests can only turn to the general advantage. But the limits are sometimes passed; and we abuse the power, given us by nature, of stifling to some extent the finest of the faculties that we draw from her.

Indeed, many men possess certain propensities which lead them constantly to resort to dissimulation; it has become necessary for them habitually to restrain the emotions of their inner feeling, and carefully to hide their thoughts and such of their actions as may lead to the end they have in view.

Now since every faculty, that is not used, gradually degenerates until it almost becomes extinct, the moral sensibility which we are here discussing is almost absent in them; and they do not even esteem it in persons who still possess it in a moderate degree.

Just as physical sensibility is only brought about by sensations which, when they give birth to some need, immediately produce an emotion in the inner feeling and thus drive the nervous fluid to the muscles which have to act; so too moral sensibility is only brought about by the emotions which thought produces in this inner feeling; and when the will, which is an intellectual act, determines some action the feeling aroused by that act guides the nervous fluid towards the suitable muscles.

The inner feeling acquires its various emotions through one or other of two very different routes, viz.: that of thought and that of physical feeling or sensations. The emotions of the inner feeling may therefore be divided:

1. Into moral emotions, such as those raised by certain thoughts;
2. Into physical emotions, such as those derived from certain sensations.

Since, however, the results of the first kind of emotion belong to the sphere of moral sensibility, while those of the second kind depend on physical sensibility, it is enough to abide by the first distinction that we established.

Nevertheless, I shall take this opportunity of making a few remarks which seem to me not without interest.

A moral emotion when very powerful may temporarily extinguish physical feeling, disturb the ideas and thoughts, and cause some enfeeblement in the functions of several of the most essential organs.

It is known that distressing news, when unexpected, as also news which causes extreme joy, produces emotions whose consequences may be of this kind.

It is also known that among the minor effects of these emotions are digestive troubles or pains; and that, in the case of elderly people, when the emotions are at all strong, they may be dangerous and even fatal.

Lastly, the power of the moral emotions is so great as often to dominate physical feeling. Fanatics, for instance, are people whose moral feeling is so exalted as to overcome the impressions of the tortures, which they are forced to undergo.

Although as a general rule the moral emotions are more powerful than the physical emotions, yet the latter when very strong may also disturb the intellectual faculties; they may even cause delirium and throw the organic functions out of order.

I shall conclude these remarks with a reflection that I believe to be well-founded, viz.: that the moral feeling exercises in course of time a greater influence on the organisation than the physical feeling is capable of working.

Indeed, almost any disturbance may be produced in the organic functions, especially in the abdominal viscera, by deep and prolonged sorrow.

Cabanis held that individuals, who are always sad and melancholy, often without any real cause, are victims of a sort of degeneration in the abdominal viscera; whence he concluded that the melancholy of these individuals must be attributed to this kind of degeneration, and therefore that these viscera contribute to the formation of thought.

It seems to me that this savant has pushed too far the conclusions to be drawn from his observations.

No doubt any degeneration of organs, and especially of the abdominal viscera, frequently corresponds to degeneration of the moral faculties and does actually contribute to it. But this condition, in my opinion, cannot be regarded as assisting in the formation of thought; it merely gives the individual a propensity towards some one kind of thoughts rather than some other.

Now it is known that the moral feeling may act strongly on the state of the organs and may affect them for a long period in some particular way; it thus appears to me that constant and real griefs in any individual may set up degeneration of the abdominal viscera; and that these degenerations, once started, may in their turn perpetuate the inclination to melancholy, even when there is no longer any real cause for it.

Reproduction, indeed, may transmit a tendency of the organs or a state of the viscera adapted for giving rise to any special temperament, inclination, or characteristic; but it is essential that circumstances should favour the development of this tendency in the new individual; for otherwise the individual would acquire another temperament, inclinations, and characteristics. It is only in animals of very low intelligence that reproduction transmits almost without variation the organisation, inclinations, habits and special peculiarities of each race.

I should travel too far afield if I were to discuss these matters further; I now therefore return to my subject.

I may sum up my observations on the inner feeling, by saying that this feeling is the source of movements and actions for beings that possess it; these occur, either when sensations, which awake needs, arouse emotions in it, or when thought similarly awakes a need or points out a danger, etc., and thus stirs it more or less strongly. These emotions, however aroused, promptly agitate the available nervous fluid: and since every need that is felt, causes the resultant emotion to affect the parts which have to act, movements are invariably carried out by this method, and are always in relation to the individual's needs.

Lastly, since these inner feelings are very obscure, the individual in whom they are working does not perceive them; yet they are real; and if man, who has a highly developed intellect, were to pay them some attention, he would soon recognise that all his acts are due to emotions of his inner feeling, some of which are inspired by ideas, thoughts, and judgments, thus making him feel certain needs, and exciting his will to action; while the others result immediately from

sudden and pressing needs, and cause him to carry out actions quite independently of his will.

I may add that, since the inner feeling may produce the agitations in question, it follows that if the individual governs the emotions of that inner feeling, he may repress or moderate them and even prevent their effects. This is how the inner feeling of any individual is a power, which leads him to act according to his needs and customary inclinations.

But when the emotions in question are so powerful as to cause an agitation in the nervous fluid sufficient to affect the movements of the portion contained in the cerebral hemispheres and also that which controls the involuntary muscles, the individual then loses consciousness, and suffers from syncope; and the functions of his vital organs are more or less deranged.

Here then we seem to have reached great truths, which the philosophers could never discover because they have not sufficiently observed nature, and which the zoologists did not perceive because they were too much occupied with matters of detail. We may at all events affirm that the physical causes, indicated above, would be capable of accounting for the phenomena of organisation into which we are enquiring.

In compliance with the ordinary rules for the exposition of ideas, I now have to establish a fundamental distinction of the first importance: I have already said that the inner feeling derives its emotions from two quite different causes:

1. From some intellectual operation culminating in an act of will;
2. From some sensation or impression, which causes a need to be felt or a propensity to be followed, independently of the will.

These two kinds of causes, which stir the inner feeling of the individual, show that there is really a distinction to be drawn among the factors which control the movements of the nervous fluid in the production of actions.

In the first case, the emotion arises from an act of intelligence, that is to say, from a judgment, which determines the will to act; and the emotion then directs the movements of the available nervous fluid in the direction impressed on it by the will.

In the second case, on the contrary, the intelligence has no share in the emotion of the inner feeling; and this emotion directs the movements of the nervous fluid in the direction demanded by the needs, to which the sensations have given rise, and in the direction of the acquired propensities.

There is another fact to be named no less important than the fore-

going: it is that the inner feeling may be suspended either entirely or in part.

During sleep, for instance, the feeling is suspended or nearly so; the free part of the nervous fluid is in a kind of repose, and no longer undergoes a general agitation; nor does the individual any longer enjoy his feeling of existence. The system of sensations is not exercised, and none of the actions dependent on the individual are carried out; the muscles necessary for their production are no longer excited, but fall into a kind of relaxation.

If sleep is imperfect, and if there exists some cause of irritation which agitates the free part of the nervous fluid, particularly that in the cerebral hemispheres, the inner feeling (being suspended) no longer directs the movements of the fluid in the nerves, and the individual is then abandoned to dreams, that is, to involuntary recurrences of his ideas following one another in characteristic disorder and confusion.

In the waking state, the functions of the inner feeling may be greatly disturbed either by too strong an emotion which cuts off the nervous fluid as it flows towards the involuntary muscles, or by some deep irritation affecting chiefly the fluid of the brain. It then ceases to direct the movements of the nervous fluid; syncope supervenes if the trouble comes from a strong emotion, or delirium if it is caused by severe irritation or some act of lunacy, etc., etc.

In accordance with the above principles, it seems to me obvious that the inner feeling is the only factor that produces actions in man and such animals as possess it; that this feeling only works when prompted by its emotions; that it is moved sometimes by acts of intelligence, sometimes by a need or sensation acting suddenly upon it; that in men, its weak emotions may be controlled since intelligence is highly developed, but that in animals this can only be done with great difficulty and never in those that lack intelligence; that its functions are suspended during sleep, and that then it no longer directs the movements of the free part of the nervous fluid; that its functions may also be interrupted and disturbed during the waking state; finally, that it is the product, on the one hand, of the individual's feeling of existence, and, on the other hand, of the harmony in the parts of the nervous system, as a result of which the free portions of the subtle nervous fluid are all in communication and capable of undergoing a general agitation.

On the same principles, it also appears to me obvious that moral sensibility only differs from physical sensibility, in that the former results exclusively from emotions prompted by acts of the intelligence; while the latter is produced only by emotions aroused by sensations and the needs which they evoke.

If these principles are well founded, they appear to me to be of the highest importance; for not only do they correct our mistakes as to the phenomena of life and organisation and the faculties to which these phenomena give rise, but they set a limit to the marvels created by our imagination; and they give a truer and higher idea of the Supreme Author of all existing things, by disclosing to us the simple method that he has adopted for working the wonders of which we are witnesses.

Hence the intimate feeling of existence possessed by animals which have the faculty of feeling but not that of intelligence, confers upon them at the same time an inner power, which only works through the emotions called up by the harmony of the nervous system, and which causes them to carry out actions without any co-operation of the will. But such animals as possess both the faculty of feeling and that of intelligence, have this advantage over the first: that the inner power, which inspires their actions, is susceptible of receiving its driving emotions either through sensations produced by internal impressions and wants that are felt, or through a will which, though more or less dependent, is always the result of some act of intelligence.

We shall now consider more attentively this singular internal power, which confers the faculty of acting on such animals as possess it: the next chapter, which is devoted to this purpose, may be regarded as a completion of the present.

CHAPTER V.

OF THE FORCE WHICH PRODUCES THE ACTIONS OF ANIMALS, AND OF CERTAIN PECULIAR FACTS RESULTING FROM THE USE OF THIS FORCE.

ANIMALS, independently of their organic movements and of the functions essential to life, carry out yet other movements and actions of which it is very important to ascertain the cause.

We know that plants can satisfy their needs without changing their position or making any sudden movement: the reason of this is that every plant in a favourable situation finds in its neighbourhood the substances which it requires for food; so that it only has to absorb them and profit by some among them.

The case is different with animals: for, with the exception of the most imperfect animals at the beginning of the animal chain, the food on which they live is not always at hand, and they are obliged to carry out movements and actions in order to procure it. Moreover, most of them have other wants to be satisfied as well, which in their turn demand other movements and other actions.

Now the question at issue was how to identify the source from which animals derive the faculty of making comparatively sudden movements of their parts;—in short, of carrying out the various activities by means of which they satisfy their needs.

I noted, in the first place, that every action is a movement, and that every movement necessarily has some cause which produces it: the question was therefore reduced to ascertaining the nature and origin of this cause.

Thereupon, when I reflected that the movements of animals are never communicated nor transmitted, but merely excited, their cause appeared to be revealed to me in the clearest and most decisive manner; and I became convinced that these movements are really in every case the product of some power which excites them.

Indeed in certain animals, muscular activity is a force fully adequate

for the production of such movements; and nervous influence is no less adequate for exciting that activity. Now I recognised that in animals, which possess physical sensibility, the emotions of the inner feeling constitute the power which drives the exciting fluid to the muscles, and the problem thus seemed to be solved as far as these animals are concerned; in the case of animals so imperfect as to possess no physical sensibility, stimuli arriving from without are obviously sufficient for their movements, for they are just as irritable or even more irritable in their parts than the others.

In my opinion, this clears up a mystery which seemed indeed difficult to penetrate; nor does this solution seem to me to rest on mere hypothesis: for in the case of sensitive animals, muscular power and the need for nervous influence to excite that power are not hypothetical; and the emotions of the inner feeling, which I regarded as being capable of driving to the muscles the fluid that excites their activity, appeared to me too manifest to be regarded as conjectural.

If now we closely consider all existing animals, including the state of their organisation, the consistency of their parts, and the various circumstances under which they live, it will be difficult not to admit that the most imperfect of them, which have no nervous system and hence no muscular activity to help their movements and actions, move by a force that is outside them, that is to say, one which they do not possess themselves and is not available at will.

It is true that it is in the interior of these delicate bodies that the subtle fluids, entering from without, set up the agitations witnessed in their parts; nevertheless it is impossible for these fragile creatures, on account of their weak coherence and extreme softness, to contain within themselves any power capable of producing their movements. It is only as a result of their organisation that these imperfect animals act in a methodical manner, which they could in no wise originate for themselves.

Now, nature has wrought her various productions by slow and gradual stages; she has created the various organs of animals in turn, varying the shape and situation of these organs according to circumstances and progressively improving their faculties. Hence we feel that she must have begun by borrowing from without, that is, from the environment, the force which produces the organic movements and those of the external parts; that she afterwards transferred that force within the animal itself, and that finally, in the most perfect animals, she made a great part of that internal force available to their will, as I shall shortly show.

If we do not carefully note the gradual order followed by nature in the creation of the various animal faculties, I believe that we shall

find it hard to explain how she could have brought feeling into existence, and still harder to conceive how simple relations between material substances can give rise to thought.

We have just seen that animals, which do not yet possess a nervous system, cannot contain within themselves the force which produces their movements, but that this force must be outside them. Now seeing that the intimate feeling of existence is entirely absent in these animals, and seeing that this feeling is the source of that internal power which produces movements and actions in those that possess it, its privation and the privation of the power resulting from it, necessitate the existence of a force to excite movements, from sources that are altogether external.

Hence in imperfect animals the force which produces both vital and bodily movements is wholly outside them: they do not even control it; but they do control to some extent, as I said above, the movements which it impresses on them, and this they do by means of their organisation.

This force is the result of subtle fluids (such as caloric, electricity, and perhaps others) which incessantly penetrate these animals from the environment, set in motion the visible and contained fluids of their bodies, and by exciting the irritability of their containing parts, give rise to the various movements of contraction which they produce.

Now these subtle fluids moving incessantly in the interior of their bodies soon carve out special routes which they always follow till new ones are open to them. Hence the similarity of the movements observed in these animals; and hence again the appearance of an irresistible propensity to carry out movements which, when continued or repeated, give rise to habits.

As a mere statement of principles is not enough, let us endeavour to elucidate the arguments on which they rest.

The most imperfect animals, such as the infusorians and especially *Monas*, only feed by means of absorption which they carry out through the pores of their skin, and by an internal imbibition of the absorbed substances. They have no power of seeking their food nor even of seizing it, but they absorb it because it is in contact with every point of their surface, and the water in which they live provides it in sufficient abundance.

These fragile animals, in which the subtle fluids of the environment are the stimulating cause of orgasm, irritability, and organic movements, carry out, as I have said, movements of contraction which, being incessantly prompted and varied by this stimulating cause, facilitate and hasten the absorptions. Now in these animals the movements of the visible contained fluids are still very slow, and the

absorbed substances make good the losses which they suffer as a consequence of life, and serve in addition for the individual's growth.

I have said that the subtle fluids which move in the interior of these living bodies cut out special routes which they continually follow, and thus begin to establish definite movements which become habits. Now if we reflect that organisation develops as life goes on, we shall understand how new routes must have been cut out, increased in number, and progressively varied for the furtherance of the movements of contraction; and how the habits to which these movements give rise then become fixed and irresistible to a corresponding extent.

Such, in my opinion, is the cause of movements in the most imperfect animals; movements that we are led to attribute to their own initiative, and to regard as a result of their faculties, because we know that in other animals the source of them is within their bodies; movements, in short, which are carried out without any will on the part of the individual, and which yet, from being very irregular in the most imperfect of these living bodies, gradually become more regular and are always the same in animals of the same species.

Finally, just as reproduction transmits acquired forms both internal and external, so too it transmits at the same time an aptitude for certain specialised types of movement and corresponding habits.

OF THE TRANSFERENCE OF THE FORCE, WHICH PRODUCES MOVEMENTS, INTO THE INTERIOR OF ANIMALS.

If nature had confined herself to her original method, that is, to a force entirely external and foreign to the animal, her work would have remained very imperfect; animals would have been simply passive machines, and nature never would have produced in such organisms the wonderful phenomena of sensibility, the intimate feeling of existence, the power of acting and, lastly, ideas, by means of which she has created the most astonishing of all, viz. thought or intelligence.

With the intention of reaching these great results, she gradually prepared the way by increasing the coherence of the internal parts of animals, by diversifying their organs, and by multiplying and compounding their contained fluids, etc.; thereafter she was able to transfer into the interior of these animals that force productive of movements and actions, which in truth they did not originally control, but which was in great part rendered available for them as their organisation became more perfect.

Indeed, when the complexity of animal organisation had gone so far as to establish a nervous system of a certain development, as among the insects, then animals provided with this organisation were endowed

with the intimate feeling of their existence; and henceforward the force productive of movements was transferred into the interior of the animal itself.

I have already shown that this internal force, which produces movements and actions, finds its origin in the intimate feeling of existence possessed by animals which have a nervous system, and that this feeling when aroused by the needs sets in motion the subtle fluid contained in the nerves, and drives it to the muscles which have to act; thus are produced the actions which the needs demand.

Now every need that is felt, produces an emotion in the individual's inner feeling; and from this emotion springs the force which gives rise to the movements required. I furnished evidence of this in setting forth the communication and harmony existing throughout the nervous system, and the way in which the inner feeling on being stirred may excite muscular activity.

Hence, in animals which contain within them the force productive of movements and actions, the inner feeling which gives rise to that force puts it in action, whenever some need is felt, and thus excites movements in the subtle fluid of the nerves (called by the ancients animal spirits); the force directs that fluid towards such of the organs as have to act, and finally causes a reflux of the fluid into its usual reservoirs, when the needs no longer require the organ to act.

The inner feeling then takes the place of will; for it now becomes important to remember that every animal which does not possess the special organ in which or by means of which thoughts, judgments, etc., are produced, has really no will, does not choose, and therefore cannot control the movements, prompted by its intimate feeling. Instinct directs these movements, and we shall see that this direction always results from emotions of the inner feeling, in which the intellect has no share, and from the organisation as modified by habit; so that the needs of such animals being necessarily limited and always the same in the same species, the intimate feeling always produces the same actions.

The case is different in animals which nature has endowed with an additional special organ (two wrinkled hemispheres surmounting the brain), for the performance of acts of intelligence, and which consequently carry out comparisons, judgments, thoughts, etc. These animals control their power of acting in proportion to the perfection of their organ of intelligence; and although they are still strongly subordinated to the habits which have modified their organisation, they yet enjoy a will that is more or less free; they can choose, and introduce variation into their actions or at least into some of them.

We shall now say a word about the consumption of the nervous

fluid which takes place in proportion as it works towards the production of animal actions.

OF THE CONSUMPTION AND DRAINAGE OF THE NERVOUS FLUID IN
THE PRODUCTION OF ANIMAL ACTIONS.

The nervous fluid, set in motion by the animal's inner feeling, is thus the motive power of the actions of these living bodies; hence it is used up in working its effects, and it would ultimately be exhausted and incapable of producing any further activity, if the individual's will kept it continually at work.

The nervous fluid, which is constantly being formed throughout life, is as constantly being consumed by the use which the individual makes of it.

One part of this fluid is kept occupied independently of the animal's will in the maintenance of vital movements and of the functions necessary to life.

The other part of the fluid is at the service of the individual and can be used either for the production of its acts and movements, or for the performance of its various acts of intelligence.

The individual thus uses up its invisible fluid in a degree proportional to the duration of the action which it produces, or to the effort which that action requires; and it would exhaust the whole of the available part, if it continued too long to carry out actions which required much of it.

Hence arises the need of rest after a certain period of action: the individual falls asleep while the exhausted fluid is recuperated.

The loss of strength, and consequently of the nervous fluid which gives strength, becomes manifest therefore in all actions that are too prolonged or are painful, and for that reason called fatiguing.

If you take too long a walk, you become fatigued after a period relative to your strength; if you run, you become fatigued much sooner, for you dissipate the principle of your strength much more rapidly and copiously; lastly, if you take a weight of fifteen or twenty pounds, and hold it out with your arm extended horizontally, you will at first find the action quite easy because you have the wherewithal to do it, but as your motive principle is rapidly used up, the weight soon seems heavier and harder to hold, and in a short time the action becomes altogether impossible.

Your organisation, however, remains the same throughout, for, if it were to be examined, no change would be found in it from the first moment, when the action was started, to the moment when you could no longer support the weight in question.

Is it not obvious that the real difference is only in the dissipation

of an invisible fluid, which we cannot perceive owing to the limitation of our available resources?

The consumption and exhaustion of the subtle fluid of the nerves in prolonged or painful actions, is certainly a fact that can never be disputed, since reason and organic phenomena afford the strongest proof of it.

Although it is true that one part of an animal's nervous fluid is constantly employed, independently of its will, in the maintenance of its vital movements and of such functions as are necessary to its existence, yet when the individual uses up too much of the free fluid available to it, the functions of its vital organs suffer. For in these circumstances the unavailable part of the nervous fluid fills the place of the available fluid that has been dissipated. It is therefore run too low, and provides inadequately for the operations of the vital organs; thereupon the functions of these organs flag to some extent, and are imperfectly fulfilled.

It is chiefly man—who is allied to animals by his organisation—that uses up his physical strength in this way; for, of all his actions, those that use the most nervous fluid are the prolonged acts of his understanding, thoughts, meditations, and, in short, the continued efforts of his intellect. The digestion is then impaired, and the physical strength is proportionally diminished.

The consumption of nervous fluid in the movements and actions of animals is so well known that I need not dwell upon it longer; but I may say that this by itself would be a sufficient proof of the existence of the fluid in the most perfect animals, if there were not many others of equal cogency.

OF THE ORIGIN OF THE PROPENSITY TOWARDS REPEATING THE SAME
ACTIONS, AND ALSO OF INSTINCT IN ANIMALS.

It is assuredly worth while to investigate the cause of the well-known phenomenon which compels nearly all animals always to repeat the same actions, and which gives rise even in man to a propensity towards any action that has become habitual.

If the principles expounded in this work are really well-founded, the causes which we seek may be very easily deduced from them; so that we shall cease to be astonished by phenomena seemingly so mysterious, when once we have recognised the simplicity of their origin.

Let us see, then, how we can account for the phenomena in question, in accordance with the principles enunciated above.

Every action is caused by some movement in the fluid of the nerves. Now when this action has been several times repeated there is no doubt

that the fluid cuts out a route which becomes specially easy for it to traverse, and that it acquires a readiness to follow this route in preference to others.

How great is the light shed by this simple and fertile principle on the power of habit—a power from which even man can only escape with great difficulty by the help of his highly developed intellect!

Who can now deny that the power of habits over actions is inversely proportional to the intelligence of the individual, and to the development of his faculty of thinking, reflecting, combining his ideas, and varying his actions?

Animals, which are only sensitive, and have not yet acquired the organ in which are produced comparisons between ideas, as also thoughts, reasonings and the various acts constituting intelligence, have nothing but perceptions (often very confused), do not reason, and can make little variation in their actions. They are therefore permanently subject to the power of habit.

Thus insects, which have the least developed nervous system of any animals that possess feeling, experience perceptions of the objects which affect them, and seem to possess a memory gained through a repetition of these perceptions. They can, however, neither vary their actions nor alter their habits, since they possess no organ to give them this power.

OF INSTINCT IN ANIMALS.

By instinct is meant the fixed tendencies displayed by animals in their actions; and many people have held that these tendencies are the produce of a reasoned choice, and therefore the fruit of experience. Others, as Cabanis said, prefer to think, in common with observers of all ages, that many of these tendencies cannot be referred to any sort of reasoning, and that, although taking their origin in physical sensibility, they are usually formed without any share of the individual's will, beyond that of improving their execution.

If attention had been paid to the fact that all animals which can feel have an inner feeling capable of being stirred by their needs, and that the resulting movements of their nervous fluid are always controlled by this inner feeling and by habit, it would then have been apparent that in all such animals that are devoid of intelligence, the tendencies of action can never be the product of a reasoned choice or judgment or experience turned to account, or will, but that they are subject to needs, excited by certain sensations, which then awake irresistible propensities. Even in animals which possess some degree of intelligence, the actions are still commonly controlled by the inner feeling and by habit.

Lastly, although the motive power of movements and actions, as also their directive cause, are exclusively internal, we must not, as has been done,¹ limit the original or prompting cause of these acts to internal impressions, with the view of attributing all acts of intelligence to external impressions; a slight knowledge of the facts is enough to show that in both cases the causes, which stimulate actions, are sometimes internal and sometimes external, and yet that they do actually give rise to impressions which only act internally.

According to the common notion attached to the word instinct, it is regarded as a torch which lights and guides animals in their actions, and which is for them what reason is for us. Nobody has shown that instinct may be a force that induces action, nor that it does induce action without any intervention of the will but only under the control of acquired propensities.

The view of Cabanis that instinct arises from internal impressions, while reasoning is the produce of external sensations, cannot be justified. It is in ourselves that we feel; our impressions can only be internal; and the sensations of external objects, derived from our special senses, cannot produce in us any but internal impressions.

When my dog is out for a walk and sees in the distance another animal of his own species, he undoubtedly experiences a sensation from that external object through the intermediary of sight. Thereupon his inner feeling, aroused by the impression received, guides his nervous fluid in the direction of a tendency acquired in all the individuals of his race; by a kind of involuntary impulse, his first movement is towards the dog that he sees. This is an act of instinct, excited by an external object, and many others of the same kind may similarly be carried out.

With regard to these phenomena, of which we find so many examples in animal organisation, it seems to me that a true and clear idea of their cause can only be found when we have recognised: (1) That the inner feeling is a very powerful generalised feeling, which has the faculty of exciting and controlling the movements of the free part of the nervous fluid and of making the animal carry out various actions; (2) that this inner feeling is capable of being moved either by acts of intelligence culminating in a will to act, or by sensations which evoke needs which in their turn immediately excite it, so that it guides the productive force of actions in the direction of some acquired propensity without the co-operation of any act of will.

There are thus two kinds of causes which may move the inner feeling, viz. those depending on intellectual operations, and those

¹ Richerand, *Physiologie*, vol. ii., p. 151.

which excite it immediately to guide its power of acting in the direction of the acquired propensities.

It is purely these last kind of causes that constitute instinct ; and seeing that they are not the produce of any deliberation, thought, or judgment, instinctive actions always satisfy surely and unerringly the wants felt and the habits acquired.

Hence instinct in animals is a compelling tendency, prompted by sensations in giving rise to needs ; and it causes the execution of actions without the intervention of any thought or act of will.

This propensity is a part of the organisation acquired by habit ; it is excited by impressions and needs, which move the individual's inner feeling, and cause it to dispatch nervous fluid to the appropriate muscles as required by the propensities.

I have already said that the habit of using any organ or any part of the body for the satisfaction of constantly recurring needs, gives the subtle fluid so great a readiness for moving towards that organ where it is so often required, that the habit becomes inherent in the nature of the individual.

Now the needs of animals with a nervous system vary in proportion to their organisation, and are as follows :

1. The need of taking some sort of food ;
2. The need for sexual fertilisation, which is prompted in them by certain sensations ;
3. The need for avoiding pain ;
4. The need for seeking pleasure or well-being.

For the satisfaction of these needs they acquire various kinds of habits, which become transformed in them into so many propensities ; these propensities they cannot resist nor change of their own accord. Hence the origin of their habitual actions and special inclinations, which have received the name of instinct.¹

This propensity of animals to the preservation of habits, and to the repetition of the resulting actions when once it has been acquired, is propagated to succeeding individuals by reproduction so as to preserve the new type of organisation and arrangement of the parts ; thus the same propensity exists in new individuals, before they have even begun to exert it.

Hence it is that the same habits and instinct are handed on from

¹ Just as all animals do not possess the faculty of will, so too instinct is not a property of all existing animals ; for those which have no nervous system have no inner feeling, and cannot therefore have any instinct for their actions.

These imperfect animals are entirely passive, do nothing of their own accord, feel no needs, and are provided for by nature in everything just as in the case of plants. Now since their parts are irritable, nature causes them to carry out movements, which we call actions.

generation to generation in the various species or races of animals, without any notable variation so long as no alteration occurs in their environment.

OF SKILL IN CERTAIN ANIMALS.

In animals which have no special organ for intelligence, the name skill, applied to certain of their actions, is scarcely deserved ; for it is only by illusion that we ascribe to them a faculty they do not really possess.

Propensities acquired and transmitted by reproduction, together with the resulting habits of carrying out complicated actions, in the face of various difficulties which are regularly and habitually overcome by emotions of the inner feeling : these constitute the sum-total of actions, always the same in individuals of the same race, to which we carelessly give the name of skill.

The instinct of animals consists in the habit of satisfying the four kinds of needs named above, and results from propensities acquired long previously, which constrain to act in a way predetermined for each species. It subsequently happened, in the case of some animals, that a complication in the actions required for the satisfaction of these four kinds of needs or of some of them, combined with various difficulties which had to be overcome, gradually forced the animal to increase and develop its methods, and led it to the performance of various new activities, without any choice or act of intelligence, but solely by emotions of the inner feeling.

Hence the origin in certain animals of various complicated actions, which people call skill, and which they are never tired of enthusiastically admiring because they always imagine, tacitly at least, that these actions are the result of thought and calculation ; this, however, is an obvious mistake. They are merely the result of a necessity which has developed and guided the habits of animals, until they reach the point at which we find them.

What I have just said is especially applicable to the invertebrates, which can carry out no act of intelligence. None of these animals indeed has any power to vary its actions, or to abandon its so-called skill in favour of some other method.

There is then nothing more wonderful in the alleged skill of the ant-lion (*Myrmeleon formica leo*) which digs out a hole in loose sand and then waits until some victim falls into the bottom of a hole by the slipping of the sand, than there is in the operation of the oyster, which for the satisfaction of all its needs has only to open slightly and close its shell. So long as their organisation remains unchanged they will both continue to do just what they do now, without any intervention of will or reasoning.

It is only among the vertebrates, and particularly among the birds and mammals, that we find the characteristics of a true skill ; for in difficult situations their intelligence may assist them to vary their actions notwithstanding their subjection to habit. These characteristics however are not common and it is only in a few races that we often witness them.

Let us now enquire what constitutes the determining motive of action, called will : and let us consider if it is actually, as has been supposed, the motive of all the actions of animals.

CHAPTER VI.

OF THE WILL.

IN the present chapter I propose to show that the will, which has been regarded as the source of all actions in animals, can only be present in those which possess a special organ for intelligence ; and that even in these, which include man himself, it is not always the motive of the actions performed.

On considering the matter, we find indeed that the will is the immediate result of an active intelligence : for it is always the effect of a judgment and hence of an idea, thought, comparison or choice ; lastly, we perceive that the faculty of willing is nothing else than that of determining by thought, that is by an operation of the organ of understanding, to perform some action, combined with the faculty of exciting an emotion of the inner feeling which can produce that action.

Thus the will is a determination towards some action, and is achieved by the intelligence of the individual : it always results from a judgment, and this judgment itself necessarily springs from an idea or thought or from some impression giving rise to such idea or thought, so that it is purely by an act of intelligence that the will, which determines an individual to some action, can be developed.

But if the will is nothing else than a determination following upon a judgment, and hence only the result of an intellectual act, it becomes clear that animals which have no organ for intelligence cannot carry out any acts of will. Yet all these animals carry out movements, which constitute their actions. There are then several different sources from which the actions of animals may be derived.

Now since the movements of all animals are excited and not communicated, there must be different kinds of exciting causes for these movements. Indeed we have seen that in certain animals these causes come entirely from without, that is to say, from the environment ; while in others, which possess an inner feeling, there is a motive power sufficient for the production of the requisite movements.

But the inner feeling, which only becomes a power when moved by a physical cause, acquires its emotions by two very different routes: in animals which have no organ for the will, the inner feeling can only be moved by means of sensations; whereas in those which have an organ for intelligence, the emotions of the inner feeling may either be the exclusive result of sensations, or that of a will born from an operation of the understanding.

Hence we have three distinct sources for the actions of animals, viz.: (1) The external causes which excite the irritability of animals; (2) the inner feeling moved by sensations; (3) the inner feeling moved by the will.

The actions or movements arising from the first of these three sources take place without the intermediary of muscles; for the muscular system does not exist in animals of this character; and when it begins to be developed, excitations from without still take the place of the non-existent inner feeling; but the actions or movements which originate from the emotions of the individual's inner feeling are only carried out through the intermediary of muscles excited by nervous fluid.

Thus when the will determines an individual towards some action, its inner feeling promptly receives an emotion, and the resulting movements are directed in such a way that the nervous fluid is immediately dispatched to the required muscles.

As to the animals which are endowed with physical sensibility, while yet possessing no organ for intelligence, and which therefore cannot carry out any act of will, their needs always result from some sensation, that is, from some perception that makes itself felt and not from any idea or judgment; and this need or perception immediately affects the individual's inner feeling. From this it follows that these animals, before acting, do not deliberate or form a judgment, and come to no preliminary determination. Their inner feeling is directly stirred by the need, and its movements are thereafter controlled by the nature of this need, so that it promptly puts in action those parts which have to move. The actions therefore which arise from this source are not preceded by a true will.

Whereas this is a necessity in the case of the animals under consideration, it is still the most frequent factor in those that are endowed with intellectual faculties; for nearly all the needs of these latter are due to sensations, which revive certain habits and thus immediately stir the inner feeling, causing these animals to act without any previous thought. Even man carries out actions of this character when the needs which prompt them are pressing. If, for instance, you absent-mindedly take up a piece of iron which

unexpectedly turns out to be very hot, the pain caused by the heat of the iron promptly moves your inner feeling; and before you have had time to think what you ought to do, your muscles have already carried out the action which consists in letting go the hot iron that you were holding.

From these observations it follows that actions carried out in consequence of needs prompted by sensations which immediately affect the individual's inner feeling, are in nowise the result of any thought, judgment, or act of will; while those which are wrought in consequence of needs aroused by ideas or propensities are exclusively the result of those acts of intelligence which also affect immediately the inner feeling and enable the individual to act by a manifest will.

This distinction between actions of which the immediate cause is in some sensation and those which result from a judgment or act of intelligence, is of great importance for the avoidance of confusion and error in our investigations of these wonderful phenomena. It is because the distinction had not been drawn that animals have been usually credited with a will in the performance of their actions; and people have supposed, on the analogy of man and the most perfect animals, that all animals have the faculty of voluntary movement. Yet this is not so, even in those that possess a nervous system, and still less in those that do not.

It is certain that animals which have no nervous system cannot possess the faculty of will; so far from it are they, that they cannot even have the feeling of their existence: the infusorians and polyps are in this position.

Those which have a nervous system capable of yielding the faculty of feeling, but which have no hypocephalon or special organ for intelligence, possess indeed an inner feeling—the mainspring of their actions—and form confused perceptions of the objects which affect them; but they have no ideas, do not think, compare or judge, and hence carry out no act of will. There is reason to believe that this is the case in the insects, arachnids, crustaceans, annelids, cirrhipedes, and even molluscs.

The inner feeling, aroused by some need, is the source of all the actions of these animals. They act without any deliberation or preliminary determination, and always in the one direction to which the need drives them; and when they encounter some obstacle while acting, if they avoid it or turn aside and seem to choose, it is only because a new need has aroused their inner feeling. Thus the new action does not result from any combination of ideas, or comparison between objects, or judgments, since these animals cannot carry out any operations of the intelligence, having no organs for the purpose;

the new action is purely a sequence of some emotion of their inner feeling.

It is therefore only the animals which, in addition to a nervous system, possess the special organ for complex ideas, thoughts, comparisons, judgments, etc., that possess the faculty of will and can carry out acts of will. This apparently is the case with the vertebrates; and since the fishes and reptiles have so imperfect a brain as not completely to fill up the cranial cavity—an indication that their acts of intelligence are extremely limited—it is mainly in the birds and mammals that the faculty of will is to be found; for they obviously carry out various acts of intelligence, and certainly have the special organ which renders them capable of such acts.

But as I have already observed: in the case of animals which have a special organ for intelligence, all the actions do not result exclusively from a will, that is, from a preliminary intellectual determination which excites the motive power of actions. Some of them are no doubt the product of the faculty of will, but many others simply arise from a direct emotion of the inner feeling, which is excited by sudden needs and causes the animal to carry out actions that are not preceded by any determination or thought.

Even in man, how many actions there are that are exclusively prompted and carried out by an emotion of the inner feeling, without any intervention of the will! Do not many of our actions owe their origin to instantaneous and uncontrolled movements; and what are these movements but results of the inner feeling?

If, as I said above, there is no true will in animals which have a nervous system without any organ for intelligence, and if this is the reason why such animals only act by emotions produced by their sensations, this truth applies still more to animals that have no nerves. It appears therefore that these latter only move by an excited irritability, and as an immediate result of external excitations.

It is easy to imagine from the above exposition that, after nature had transferred the power of acting into the interior of animals, that is, after she had created the inner feeling based on the nervous system as the origin of the force for producing actions, she then perfected her work by creating a second internal power, that, viz. of the will, which arises from acts of intelligence and is the only faculty that can cause any variation in the habitual actions.

For this purpose, nature was obliged to add a new organ to the nervous system, in which acts of intelligence might be carried on; and she had to separate the nucleus of sensations or perceptions from the organ of ideas, comparisons, judgments, reasonings, thoughts.

Thus in the most perfect animals the spinal cord provides for the

muscular movement of the parts of the body, and for the maintenance of the vital functions; while the nucleus of sensations, instead of being situated throughout the length, or in any isolated part of the spinal cord, becomes concentrated at its superior or anterior extremity in the inferior part of the brain. This nucleus of sensations is therefore quite close to the organ in which are carried out the various acts of the intelligence, and is yet separate from it.

When animal organisation has reached the limit of perfection implied by an organ for acts of intelligence, the individuals which possess such an organisation have simple ideas, and may form complex ideas. They possess a will, free in appearance, which determines some of their actions; they have passions, that is, heightened inclinations which draw them towards certain kinds of ideas and actions beyond their control; lastly, they are endowed with memory and have the faculty of calling up ideas previously traced in their organ, a process which is due to the nervous fluid passing over, and being acted on by, the impressions or traces implanted by these ideas.

It seems probable that the disturbed agitations of the nervous fluid in contact with these traces are the cause of dreams, which often call up ideas in animals during sleep.

Animals which have intelligence yet carry out most of their actions by instinct and habit, and in this respect they never make a mistake; when they act by will, that is, as the effect of a judgment, they still make no mistakes, or, at least, very rarely so; because the elements which enter into their judgments are few in number and usually furnished by sensations, and still more because in any one race there is no inequality in the intelligence and ideas of individuals. Hence it follows that their acts of will are determinations which lead them always unerringly to the satisfaction of their needs. For this reason it has been said that instinct is for animals a torch which lights them better than our reason.

The truth is that animals are less free than ourselves to vary their actions and more subject to habit, and hence that they find in their instinct a compelling necessity, and in their acts of will only a cause the elements of which are invariable, unmodified, quite simple and always the same in individuals of the same race; so that it has in all an equal power and extent. Finally, since there is no inequality in the intellectual faculties of individuals of the same species, their judgments and their will, resulting from these judgments, cause them always to carry out the same actions in the same circumstances.

I shall conclude these theories on the origin and results of the will by some remarks on this faculty in man. We shall then see that things are quite different in his case from what they are in the case of animals;

for although his will seems to be much freer than theirs, it is not really so ; and yet, for a reason that I shall try to explain, individuals of his species act very differently under similar circumstances.

Since the will is always dependent on some judgment it is never really free ; for the judgment which gives rise to it is a necessary result of the union of its component elements, like the quotient in an arithmetical operation. But the produce of a judgment must vary in different individuals for the reason that the elements which enter into the formation of this judgment are apt to be quite different in different individuals.

In fact, so many and various elements enter into the formation of our judgments, so many are present which ought not to be present, and of the proper elements so many are unnoticed or rejected from prejudice, or are affected by our disposition, health, age, sex, habits, propensities, state of our knowledge, etc., that the union of these elements gives rise to very different judgments on the same subject in different individuals. The fact that our judgments depend on so many inappreciable elements has given rise to the belief that our determinations are free, although in reality they are not so, seeing that the judgments which produce them are not free themselves.

The diversity of our judgments is so remarkable that it often happens that a subject gives rise to as many individual judgments as there are persons to discuss it. This variation has been taken for a freedom of determination, and a mistake has thus been made ; for it is only the result of the difference between the elements entering into the judgment of each person.

Yet there are subjects so simple and straightforward that the judgments passed upon them are in almost universal agreement. But these subjects are almost exclusively confined to what is outside of us, and only known by the sensations which they excite or have excited on our senses. Our judgments with regard to them involve scarcely any elements other than those furnished by sensation together with the comparisons which we draw between these and other known bodies. Lastly, for this class of judgment there is very little call upon our understanding.

One result of the immense number and variety of the causes which affect the elements entering into the formation of our judgments, especially those which require various intellectual operations, is that these judgments are usually erroneous and inaccurate ; and that on account of the inequality between the intellectual faculties of individuals these same judgments are commonly as varied as the people who form them, each one importing different elements into them. Hence it follows, moreover, that disorders of these acts of

intelligence necessarily involve others in our wills and consequently in our actions.

If the scope of the present work permitted, I might adduce many instances in support of these observations ; I might even make remarks that would not be without interest.

I might show, for instance, that while man derives great advantages from his highly developed intellectual faculties, the human species in general suffers from them at the same time considerable disadvantages ; since these faculties confer the means for doing harm as easily as good, and their general effect is always to the disadvantage of those individuals who make least use of their intelligence, and this is necessarily the case of the greater number. It would appear therefore that the main evil in this respect resides in the extreme inequality of intelligence between individuals, an inequality that cannot be entirely destroyed. Nevertheless it may be inferred with still greater certainty that the thing most important for the improvement and happiness of man is to diminish as far as possible this enormous inequality, since it is the origin of most of the evils to which he is exposed.

Let us now endeavour to ascertain the physical causes at work in acts of the understanding : we shall try at least to determine what are the necessary conditions of the organisation in order that these wonderful phenomena may be produced.

CHAPTER VII.

OF THE UNDERSTANDING, ITS ORIGIN, AND THE ORIGIN OF IDEAS.

THIS is the most curious and interesting, and at the same time the most difficult subject presented to man in his studies of nature; it is the subject in which it is most important for him to possess positive knowledge, while yet offering the fewest facilities for its acquisition.

The question is, how purely physical causes, that is to say, simple relations between different kinds of matter, can produce what we call ideas; how, out of simple or direct ideas, complex ideas may be formed; how, in short, out of ideas of any kind, faculties can arise, so astonishing as those of thought, judgment, analysis and reasoning.

He indeed is more than bold who undertakes such a research, and flatters himself that he has found in nature the origin of these wonderful phenomena.

Assuredly, I have not the presumption to suppose that I have discovered their causes; but I started with the conviction that all acts of intelligence are natural phenomena and hence derive their source exclusively from physical causes. Seeing that the most perfect animals enjoy the faculty of producing them, I thought that by careful observation, attention, and patience, I might reach, especially through induction, ideas of great moment on this important subject; I now have to present my conclusions.

Under the title of understanding or intelligence I include all known intellectual faculties, such as those of forming ideas of various kinds, of comparing, judging, thinking, analysing, reasoning, and, lastly, of recalling ideas previously acquired as well as past thoughts and reasonings; this faculty constituting memory.

All these faculties unquestionably result from acts peculiar to the organ of intelligence, and each such act is necessarily the product of relations subsisting between that organ and the nervous fluid moving in it.

The special organ in question, to which I have given the name of hypocephalon, consists of two wrinkled pulpy hemispheres, investing or covering that medullary region which I call more strictly the brain, and which contains the nucleus or centre of communication of the nervous system and gives rise to the nerves of the special senses; the cerebellum is a mere appendage of it.

This region (the brain properly so-called, including the cerebellum) and the hypocephalon are quite distinct from each other, especially as regards their functions, although they are commonly confused together under the general name of brain or encephalon. Now it is in the functions of the hypocephalon alone that I shall seek the physical causes of the various intellectual faculties, because this organ is the only one that has the power of giving rise to them.

Though not easily recognised, there is a real differentiation in the parts of this organ. This differentiation and the varied movements of the contained subtle fluid are the only origin of the different intellectual acts which I have named. This is the general idea, which I propose briefly to develop.

At the outset, in order to introduce some order into our discussions we must posit or recall the two following principles which are at the base of all legitimate hypotheses on this subject.

First principle: All intellectual acts whatever originate from ideas, acquired either at the time or previously, for these acts may always be reduced to ideas, or relations between ideas, or operations on ideas.

Second principle: Every idea of any kind originates either directly or indirectly from a sensation.

Of these two principles, the first is fully confirmed by an investigation as to what the various acts of the understanding really consist of; in all such acts, ideas are invariably the subject or material of the operations carried out.

The second of these principles had been recognised by the ancients, and is perfectly expressed in that axiom, which Locke has so successfully sustained, viz.: *That there is nothing in the understanding which was not previously in sensation.*

Hence it follows that every idea must in the last analysis be resolved into an image perceived, and that since whatever is in our understanding came there *via* sensation, all that issues from it and can find no perceptible object to fasten upon is absolutely chimerical. This is the obvious conclusion drawn by M. Naigeon from Aristotle's axiom.

The axiom however is not yet universally admitted, for many people hold, on account of certain facts whose causes they do not perceive, that there really are innate ideas. They persuade themselves that they

have found a proof of it in the child which a few minutes after birth tries to suck, and seems to look for its mother's breast, although it can still have no knowledge of it through freshly acquired ideas. I shall refrain from citing the alleged case of a kid which when dragged from its mother's breast selected laburnum from several plants offered it. It is well known that this was a mere imagination, which cannot have been well-founded.

When once we have recognised that habits are the source of propensities, that continued exercise of these propensities modifies the organisation in a corresponding direction, and that they are then transmitted to new individuals by reproduction, we shall see how the newly born child may try to suck by pure instinct, and may take the breast offered it without having the slightest idea of it, or carrying out any thought, judgment, or act of will; and we shall further see that the child performs this action exclusively through the slight emotion which the need raises in its inner feeling, so as to make it act in the direction of an acquired propensity without any previous experience; we shall see in the same way that the duckling just out of the egg, if it is in the neighbourhood of water, immediately runs to it and swims about on the surface, without having any idea of it or knowing what it does. The animal does not perform this action by any intellectual deliberation, but by a transmitted propensity evoked by its inner feeling without any call upon the intelligence.

I lay down, then, as a fundamental principle and unquestionable truth, the proposition that there are no innate ideas, but that all ideas whatever spring either directly or indirectly from sensations which are felt and noticed.

From this principle it follows that the organ of intelligence, being the ultimate perfection which nature has bestowed on animals, can only exist in those which already possess the faculty of feeling. Hence the special organ in which are carried out ideas, judgments, thoughts, etc., only begins to be formed in animals with a highly developed system of sensations.

All intellectual acts occurring in an individual are due therefore to a combination of the following causes, viz. :

1. The faculty of feeling;
2. The possession of a special organ for intelligence;
3. The relations subsisting between this organ and the nervous fluid moving freely about in it;
4. Lastly, the fact that the results of these relations are always conveyed to the nucleus of sensations, and therefore to the individual's inner feeling.

This is the chain which is in harmony throughout, and constitutes

the developed physical cause of the most wonderful of natural phenomena.

To set up a reasonable opposition to the views stated above, it would be necessary to show that the harmony existing throughout the nervous system is not capable of producing sensations and the individual's inner feeling; that intellectual acts, such as thoughts, judgments, etc., are not physical acts, and do not result immediately from relations between a subtle agitated fluid and the special organ containing it; lastly, that the results of these relations are not transmitted to the individual's inner feeling. Now the physical causes named above are the only ones that can possibly give rise to the phenomena of intelligence. If therefore the existence of these causes is denied, and if consequently it is denied that the resulting phenomena are natural, it will then be necessary to seek another source of these phenomena outside nature. It will be necessary to substitute for the physical causes rejected, fantastic ideas of our own imagination, ideas that are always baseless since it is quite obvious that we can have no other positive knowledge than that derived from the actual objects which nature presents to our senses.

Since the marvels which we are investigating, and whose causes we are seeking, are based upon ideas, and since in acts of intelligence we are dealing only with ideas and operations on ideas; before enquiring what ideas themselves are, let us illustrate the gradual formation of the organs which give rise firstly to sensations and the inner feeling, then to ideas and, lastly, to the operations performed upon them.

The very imperfect animals of the earlier classes, having no nervous system, are simply irritable and merely have habits without feeling any sensations or ever forming ideas. But the less imperfect animals, which have a nervous system without, however, the organ of intelligence, have instinct, habits and propensities and feel sensations, while yet forming no ideas. I venture to affirm that where there is no organ for a faculty, that faculty cannot exist.

Now if we admit that every idea originates from a sensation, which indeed cannot seriously be disputed, I hope to show that it does not follow that every sensation necessarily yields an idea. The organisation must have reached a state favourable to the formation of the idea, and, moreover, the sensation must be accompanied by a special effort of the individual, in short, by a preparatory act which renders the special organ of intelligence capable of receiving the idea, that is, of retaining impressions.

Indeed, if it is true that in creating organisation, nature necessarily began by forming it in extreme simplicity without the intention of giving living bodies any other faculties than those of feeling and

reproducing, those bodies which were endowed by her with organisation and life could have no other organs than those necessary for the maintenance of life. This fact is confirmed by observation of the most imperfect animals, such as the infusorians and polyps.

But when she subsequently complicated the organisation of these earliest animals and created, with the help of long periods of time and an infinite diversity of circumstances, the multitude of different forms which characterise the later classes, nature formed successively the various organs which animals possess and the different faculties to which these organs give rise. She produced them in an order that I have determined in Part I., Chapter VIII., and from this order it may be seen that the hypocephalon, consisting of the two wrinkled hemispheres covering the brain, is the last organ which she brought into existence.

Long before creating the hypocephalon, or special organ for the formation of ideas and of all the operations carried out upon them, nature had established in a great number of animals a nervous system, which gave them the faculty of exciting muscular activity, and afterwards of feeling and acting by the emotions of their inner feeling. Now although for this purpose she had multiplied and scattered the nuclei for muscular movement either by establishing separate ganglia, or by distributing these nuclei throughout the length of a ganglionic longitudinal cord or spinal cord, yet she concentrated the nucleus of sensation in a special locality and fixed it in a small medullary mass, which gives direct origin to the nerves of some special senses and which has received the name of brain.

It was therefore only after having wrought these various perfections of the nervous system that nature put the finishing touch on her work by creating, in close proximity to the nucleus of sensations, the hypocephalon, that remarkable and interesting organ in which ideas are graven and where all the operations constituting intelligence are carried out.

It is exclusively these operations that we shall study, in our endeavours to determine their most probable physical causes, by careful inductions and a knowledge of the conditions required.

Let us now investigate how an idea comes to be formed, and under what conditions a sensation can produce it; let us even enquire, at least in outline, in what way acts of the intelligence are carried out in the hypocephalon.

It is a very singular circumstance that the special organ now under consideration never exerts any action itself in any of the acts or phenomena to which it gives rise, and that it does nothing more than receive and preserve for a longer or shorter period the images transmitted to it

and the impressions graven upon it. This organ, together with the brain and nerves, differs from all the other organs of the animal body in that it is not active, and does no more than provide the means for the nervous fluid to carry out its various phenomena.

Indeed, when I remember the extreme softness of the medullary pulp constituting the nerves, brain, and hypocephalon, I cannot think that in the relations of the nervous fluid with the medullary parts, the latter are capable of exerting the slightest action. Beyond doubt these parts are entirely passive and unable to react upon anything that affects them. Hence it results that the medullary parts, of which the hypocephalon consists, receive and preserve the traces of all the impressions made upon them by the movements of the nervous fluid; so that the only active element in the functions of the hypocephalon is the nervous fluid itself; or to express the matter more precisely, the organ carries out no function, the nervous fluid by itself carries out all; but this fluid could in no wise give rise to them without the existence of the organ in question.

I may be asked how it is possible to conceive that any fluid, however subtle and varied its movements, can by itself give rise to that astonishing variety of acts and phenomena characteristic of the intellectual faculties. To this I reply, that the entire marvel is in the composition of the hypocephalon itself.

The medullary mass constituting the hypocephalon, that is, the two wrinkled hemispheres which cover over the brain,—this mass, I say, which seems to be only a pulp, whose parts are continuous and coherent throughout, consists, on the contrary, of an inconceivable number of separate and distinct parts, from which result a vast quantity of cavities of infinitely varied size and shape and appearing to occupy distinct regions, equal in number to the intellectual faculties of the individual; lastly, however it may come about, the composition of the organ is different in each region, for each is devoted to some individual faculty of the intelligence.

The examination of the white medullary part of the hypocephalon has disclosed numerous fibres in it: now it is probable that these fibres are not, as elsewhere, organs of movement; their consistency would not permit of it: there is more reason to believe that they are so many individual canals, each terminating in a cavity which would be in the form of a cul-de-sac unless they communicate together by lateral paths. These cavities, which are imperceptible to us, are as innumerable as the tubular threads leading to them; and it may be presumed that it is on their internal walls that the impressions brought by the nervous fluid are engraved; there may also be little medullary plates or leaves for the same purpose.

Since we cannot know what is actually the case on this subject, I believe I have attained my purpose by showing what may be the case or even probably is the case : for I can do no more.

The wonderful composition of the hypocephalon, both in its main features and in its individual regions, which are all duplicated, one being in each hemisphere, is more than a mere hypothesis, in spite of the fact that we lack the means for seeing it and assuring ourselves of it. The organic phenomena constituting the intelligence, and the fact that each of these phenomena requires a special locality in the organ and indeed a special organ, so to speak, for its production, should give us a moral conviction that the composition of the hypocephalon is as I have represented it.

Certainly, individuals are not born in possession of all their possible intellectual faculties, for the organ of intelligence, like the rest, develops according to its use. The same applies with each special kind of intellectual faculty : it is brought into existence in the appropriate region of the hypocephalon by the needs that are felt ; and in correspondence with the frequency of the repetition of these acts, the special organ adapted to them develops and enlarges its faculty.

It is therefore not true that any of our intellectual faculties are innate ; and this applies also to those of our propensities which depend on the faculty of thought. These faculties and propensities grow and strengthen according to the exercise which we give to their underlying organs. We may indeed derive certain tendencies from our inherited organisation : but unless we exercise these faculties and inclinations ourselves we gradually lose the aptitude for them.

Dr. Gall having noticed that some individuals had particular faculties, more developed and conspicuous than others, conceived the idea of enquiring whether any part of their body might not present some external signs by which this faculty could be recognised.

He does not seem to have studied any faculties but those connected with the intelligence ; for if he had he would have met with abundant evidence that any part which is much exerted and has acquired a highly developed faculty, always exhibits manifest signs of it in its size, shape, and vigour. We cannot look at the posterior extremities and tail of a kangaroo, without being convinced that these much used parts possess great power of action, a fact which also applies to the posterior legs of grasshoppers, etc. In the same way, when we reflect upon the immense growth of the elephant's nose, which has been transformed into an enormous trunk, we cannot help recognising that the habitual exercise of this organ, which is used by the animal as a hand, is accountable for its size, strength, and wonderful suppleness, etc., etc.

But M. Gall seems to have particularly devoted himself to a search for the external signs which might indicate a high eminence of intellectual faculties in certain individuals. He recognised that all these faculties are based upon functions of the cerebral organ, and therefore directed his attention to the encephalon. After some years of research, he became convinced that those of our intellectual faculties, which are greatly developed and have acquired a high degree of complexity, may be recognised by external signs consisting of certain protuberances of the cranium.

M. Gall certainly founded his theory on a sound principle : for if it is true, as I have sufficiently proved in Part I., Chapter VII., that all parts of the body which are vigorously and constantly used, acquire a characteristic development and strength of function, the same must hold good equally for the organ of understanding in general, and even for each of the special organs which compose it : so much is certain and easy to demonstrate by many established facts.

M. Gall's underlying principle therefore is beyond criticism ; but the results of enquiries into the doctrines taught by this savant give rise to the belief that he misapplied his theory, as regards most of the inferences which he drew from it.

As a matter of fact, in the case of the special organs which enter into the composition of the two cerebral hemispheres and give rise to the different kinds of intellectual faculties, the principle seems to me to be much less applicable than M. Gall supposes ; and indeed it can only be in a very small number of extreme cases that certain faculties which have acquired extraordinary power may present indubitable external signs of their existence. In such cases I should not be in the least surprised at the discovery of some such signs, since they have a true natural cause. But with regard to our intellectual faculties, M. Gall has lost sight of the larger distinctions, to embark upon a crowd of details, including even the gradations between these faculties ; and this in my opinion is an instance of a very ordinary abuse of the imagination, which destroys the value of our discoveries in the study of nature. And now because M. Gall wanted to prove too much, the public have fallen into the opposite extreme and rejected the whole. Such is the usual progress of the human mind in its various acts ; the good that has been done is most often spoilt by excess and abuse. The exceptions to this rule are only found in a small minority of persons who by the aid of a powerful reason set limits to the imagination which tends to carry them away.

To regard certain propensities which have become altogether dominant as innate in the human species, is not only a dangerous belief but also a genuine mistake. We may no doubt possess at birth

special tendencies transmitted from the organisation of our parents, but it is certain that if we did not strongly and habitually exercise the faculties favoured by these tendencies, the special organs concerned would never have developed.

In truth, every individual, from the moment of his birth, is in the midst of a set of circumstances altogether peculiar to himself, which to a large extent contribute to make him what he is at the different stages of his life, and which put him in the way of exerting or not exerting one or other of his faculties or inherited tendencies; so that it may be said in general that we only have quite a moderate share in bringing about the condition in which we find ourselves throughout our existence, and that we owe our tastes, propensities, habits, passions, faculties, and knowledge to the infinitely varied but special circumstances in which each of us has been placed.

From our earliest infancy, those who bring us up sometimes leave us entirely at the mercy of surrounding circumstances, or themselves create circumstances highly disadvantageous to us by their mode of life, thought, and feeling; and sometimes by ill-advised weakness they spoil us and let us acquire many pernicious faults and habits, whose consequences they do not foresee. They laugh at what they call our tricks, and make jokes over all our follies, in the belief that they will be able later on easily to change our vicious inclinations and correct our faults.

It is difficult to conceive how great is the influence of early habit and inclinations on the propensities which will some day dominate us, and on the character which we form. The very pliable organisation of early youth yields readily to the habitual movements of our nervous fluid in one or other direction, in correspondence with our inclinations and habits. The organisation thence acquires a modification which may increase under favourable circumstances, but which can never be entirely obliterated.

It is in vain that after our infancy, we make efforts to guide our inclinations and actions by means of education towards whatever may be useful to us, in short, to give ourselves principles to form our reason and manner of judging, etc. We meet with so many circumstances that are difficult to master, that we are each of us, so to speak, constrained by them and gradually acquire a mode of life in which we ourselves have only had a very small share.

I need not here enter upon the numerous details which form a special environment for each individual, but I must observe, since I am convinced of it, that everything tending to make any of our actions habitual modifies our internal organisation in favour of that action; so that as a result this action becomes a sort of necessity for us.

Of all parts of our organisation, that which most readily undergoes modifications, due to some acquired habit of thought, idea, or action, is our organ of intelligence. Now the region which is modified is necessarily that concerned with the ideas or thoughts which habitually occupy us. I repeat, then, this region of our intellectual organ when vigorously exercised acquires a development which may finally become noticeable by external signs.

We have dealt with the general principles concerning the organ which gives rise to intelligence; we shall now pass on to an enquiry into the formation of ideas.

FORMATION OF IDEAS.

My purpose here is not to undertake any analysis of ideas, nor to show how they become compounded and increased, nor, in short, how the understanding is perfected. Many celebrated men since Bacon, Locke, and Condillac, have dealt with these matters and greatly illuminated them. I need not therefore stay to consider them.

My purpose is simply to indicate by what physical causes ideas may be formed, and to show that comparisons, judgments, thoughts, and all operations of the understanding are at the same time physical acts, which result from the relations between certain kinds of matter in action, and which are carried out in a special organ which has gradually acquired the faculty of producing them.

All that I have to say on this important subject is entirely a matter of probabilities. All is a product of imagination; limited however by the necessity for admitting nothing but physical causes compatible with the known properties of matter, nothing, in short, but causes which may be and probably are correct. With regard to the physical acts which I shall endeavour to analyse, none of them can be witnessed and none therefore can be proved.

I should mention that ideas are of two distinct kinds, viz. :
Simple or direct ideas; complex or indirect ideas.

By simple ideas I mean those which spring immediately and exclusively from the noticed sensations that are impressed upon us by objects either within or without us.

By complex ideas I mean those which are found within us as a result of some operation of our understanding, performed on previously acquired ideas; they therefore require no immediate sensation.

Ideas of all kinds are the result of images or special outlines of objects which have affected us; these images or outlines only become ideas for us, when they have been traced on some part of our organ; and the nervous fluid then passes over them and carries back the result to our inner feeling, by which we become conscious of it.

Not only do ideas originate in two different ways, but a distinction has also to be drawn between those which only become perceptible to us in company with the sensation which produced them, and those which are presented to our consciousness without any accompanying sensation.

The former I call *physico-moral* ideas, and the latter *moral ideas* simply.

Physico-moral ideas are clear, vivid, and sharply defined, and are felt with all the force that they derive from their accompanying sensation. Thus the sight of a building or any other object under my eyes to which I pay attention, gives rise in me to one or several ideas by which I am vividly affected.

Moral ideas, on the other hand, both simple and complex, of which we only become conscious as the result of an operation of our understanding excited by our inner feeling, are very vague and ill-defined and do not affect us with any vividness, although we are sometimes stirred by them. Thus, when I recall an object that I have seen and noticed, a judgment that I have formed, a reasoning which I have carried out, etc., the idea only affects me in a weak and vague manner.

We must then beware of confusing what we experience when we have the consciousness of some idea, from what we experience when a sensation affects us and we pay attention to it.

All that we are conscious of only comes to us through the organ of intelligence, and whatever causes sensation in us works firstly through the sensitive organ and afterwards through the idea that we form of it, if we happen to pay attention to it.

It is essential, therefore, to distinguish moral from physical feeling, since experience of the past teaches us that a failure to recognise that distinction has led men of the highest ability to draw up theories which now have to be destroyed.

No doubt both feelings are physical, but the difference in the terms that I use to distinguish them is sufficient for the purpose that I have in view, and moreover they are the terms in common use.

By moral feeling I mean the feeling that we experience when an idea or thought or any act of our understanding is transmitted to our inner feeling, so that we then have consciousness of it.

By physical feeling I mean the feeling which we experience from some sensation due to an impression on any of our senses and compelling our attention.

These clear and simple definitions must show that the two things are quite different from one another, both as regards their origin and their effects.

It is however through confusing them, as Condillac had done, that M. de Tracy has said :

“Thinking is only feeling, and feeling is for us the same thing as existing ; since it is sensations that tell us of our existence. Ideas or perceptions are either true sensations or recollections, or affinities that we perceive, or indeed the desire that may be raised in us by these affinities : the faculty of thought is thus sub-divided into true sensibility, memory, judgment, and will.”

In all this there is clearly a confusion between sensations and the consciousness of our ideas, thoughts, judgments, etc. It is a similar confusion between moral feeling and physical feeling that has led to the belief that every creature, which possesses the faculty of feeling, also has that of intelligence ; for this is certainly ill-founded.

Sensations no doubt tell us of our existence, but only when we pay attention to them. That is to say, we have to think of them, and this is an act of intelligence.

Thus, in the case of man and the most perfect animals, sensations that are noticed acquaint them with existence and give ideas ; but in the case of the more imperfect animals, such for instance, as the insects, in which I recognise no organ for intelligence, sensations cannot be remarked, nor yield ideas ; and they can only form simple perceptions of the objects which affect the individual.

Yet the insect possesses an inner feeling capable of emotions which make it act ; but since there is no idea connected with it, it cannot be conscious of its existence ; in short, it never experiences any moral feeling.

In the case of all creatures endowed with intelligence, we must therefore say : to think is to feel morally, or to have consciousness of one's ideas and thoughts, and also of one's existence ; but this is not the same as physical feeling, for the latter is a product of the system of sensations while the former comes from the organic system of intelligence.

SIMPLE IDEAS.

A simple idea, arising from a sensation of some object affecting one of our senses, can only be formed when the sensation is remarked, and when the result of the sensation is transmitted to the organ of intelligence and traced or graven on some part of it ; this result is perceived by the individual because at the same moment it affects his inner feeling.

Indeed every individual which possesses the faculty of feeling and also an organ for intelligence, promptly receives in this organ the image or outlines brought by the sensation of any object, if the organ is prepared for it by attention. Now these outlines or image of the object reach the hypocephalon by means of a second reaction of the

nervous fluid, which, after having produced sensation, carries into the intellectual organ the particular agitation which it derived from that sensation, impresses on some part of it the characteristic outlines of its movement, and finally renders them perceptible to the individual by transmitting their effects to his inner feeling.

The ideas formed on seeing a sky-rocket for the first time, on hearing a lion's roar, and on touching the point of a needle are simple ideas.

Now the impressions which these objects make upon our senses immediately excite in the fluid of the corresponding nerves an agitation which is different in each case; the movement is propagated to the nucleus of sensations; the whole system immediately shares in it; and sensation is produced by the mechanism that I have already explained.

Thus, if our attention has prepared the way, the nervous fluid instantly conveys the image of the object or some of its outlines to our organ of intelligence, and impresses that image or those outlines on some part of the organ; the idea traced is then immediately carried back by it to our inner feeling.

In the same way that the nervous fluid by its movements is the agent for carrying to the nucleus of sensations the impressions of external objects that affect our senses, so too this subtle fluid is the agent for conveying from the nucleus of sensations to the organ of intelligence the product of each sensation that is raised, for tracing its outlines there or impressing them on it by its agitations if the organ has been prepared by attention, and for subsequently carrying back the resultant to the individual's inner feeling.

Thus, in order that the outlines or image of the object which has caused the sensation may reach the organ of understanding and be impressed on some part of it, it is necessary that the organ should first be prepared by an act of attention for receiving the impression, or that this act should open the way by which the product of that sensation may travel to the organ where the outlines of the object may be impressed: in order that any idea may arise or be recalled in consciousness, it is necessary again by means of attention that the nervous fluid should convey its outlines to the individual's inner feeling; this idea then becomes perceptible to him and may be recalled at the will of the individual for a longer or shorter period.

The impression which forms the idea is thus actually traced and graven on the organ, since memory can recall it at the will of the individual and make it perceptible once more.

This in my opinion is the probable mechanism of the formation of ideas; the mechanism by which we recall them at will until time has obliterated or blurred their outlines so that we can no longer remember them.

To try to determine how the agitations of the nervous fluid trace or engrave an idea on the organ of understanding, would be to court the risk of committing one of those numerous errors to which the imagination is liable; all that we can be sure of is that the fluid in question is the actual agent which traces and impresses the idea; that each kind of sensation gives a special agitation to this fluid and consequently causes it to impress equally special outlines on the organ; and, lastly, that the fluid acts upon an organ so soft and delicate and finds its way into such narrow interstices and tiny cavities, that it can impress on their delicate walls traces more or less deep of every kind of movement by which it may be agitated.

Do we not know that in old age, when the organ of intelligence has lost some of its delicacy and softness, ideas are graven less deeply and with greater difficulty; that memory, which is gradually being lost, only recalls ideas graven long ago upon the organ, since they were then more easily and deeply impressed?

Moreover, with regard to the organic phenomenon of ideas, we are dealing exclusively with relations between moving fluids and the special organ which contains them. Now for operations so swift as ideas and all intellectual acts, what other fluid could produce them but the subtle and invisible fluid of the nerves, a fluid so analogous to electricity; and what organ could be more appropriate for these delicate operations than the brain?

Thus a simple or direct idea is formed, whenever the fluid of the nerves is agitated by some external impression or even by some internal pain, and conveys the agitation to the nucleus of sensations, and when attention has prepared the way for the further conveyance of that agitation to the organ of intelligence.

As soon as these conditions are fulfilled, the impression is immediately traced upon the organ, the idea comes into existence and is at once perceived because the individual's inner feeling is affected by it; lastly, the idea may be called up afresh by memory, although obscurely, whenever the individual directs the nervous fluid over the subsisting traces of that idea.

Every idea recalled by memory is therefore much vaguer than when it was formed; because the fact which renders it perceptible does not then result from a present sensation.

COMPLEX IDEAS.

By a complex or indirect idea, I mean one that does not arise immediately from the sensation of some object, but is the result of an act of intelligence working on ideas already acquired.

The act of understanding which gives rise to the formation of a

complex idea is always a judgment ; and this judgment itself is either a consequence or a determination of a relationship. Now this act appears to me to be due to the resultant movement of the nervous fluid which has been broken up by the inner feeling into separate streams, each of which traverses previously made impressions of certain ideas, and thence undergoes special kinds of modifications in its movements. When the streams reunite their individual movements are then combined into this resultant movement.

It is then by means of this movement of the nervous fluid, which is really due to compared ideas or to relations between them, that the subtle fluid makes its impressions on the organ and at the same moment transfers the effect to the individual's inner feeling.

Such is in my opinion the physical cause and precise mechanism which give rise to the formation of all kinds of complex ideas. These complex ideas are quite distinct from simple ideas, since they do not result from any immediate sensation or impression on any of our senses, but originate from several ideas already impressed, and, further, are exclusively due to an act of the understanding in which the sensitive system has no share.

There is this difference between the act of understanding which forms a judgment whence arises a complex idea, and that called a recollection or act of memory, which merely consists in recalling ideas to the individual's inner feeling : that in the former case the ideas employed take part in an operation resulting in a new idea, whereas in the second case the ideas employed take part in no operation, give rise to no new idea, but merely become present to the individual's consciousness.

If it is true that the emotions of our inner feeling give us the faculty and power of acting, and that they enable us to put our nervous fluid in motion and direct it over the impressions of various ideas made upon different parts of the recipient organ, it is obvious that this subtle fluid, while passing over the tracings of any idea, will undergo a special modification in its mode of agitation. We may suppose that, if the nervous fluid simply brings back this special modification of its agitation to the individual's inner feeling, it only makes the idea perceptible or present to the individual's consciousness ; but if the fluid, instead of merely passing over the tracings or image of a single idea, divides into several streams, each of which travels over some individual idea, and if the streams then all reunite, the resultant movement of the combined fluid will impress on the organ a new and complex idea, and will then transfer its effect to the individual's consciousness.

If we form complex ideas out of pre-existing simple ideas, we shall have, as soon as they are impressed on our organ, complex ideas of the first order : now it is obvious that if we compare together several

complex ideas of the first order by the same organic means with which we compared simple ideas, we shall obtain a resultant judgment of which we form a new idea ; this will be a complex idea of the second order, since it arises from several previously acquired complex ideas of the first order. In this way complex ideas of various orders may be multiplied almost to infinity, as indeed we see in most of our reasonings.

Thus there are carried out in the organ of intelligence various physical acts which give rise to the phenomena of comparison, judgment, analysis of ideas, and reasoning, and these different acts are only operations on ideas already traced, due to the resultant movement acquired by the nervous fluid when it impinges on their tracings or images : and since these operations on pre-existing ideas and even on series of ideas, taken in turn or all together, are only relations sought out by thought through the inner feeling between the various kinds of ideas, these same operations culminate in results which we call judgments, inferences, conclusions, etc.

In the same way, intellectual phenomena are physically produced in the most perfect animals. They are no doubt of a very inferior order, but they are altogether analogous to those described above ; for these animals do receive ideas and have the faculty of comparing them and drawing judgments from them. Their ideas are therefore actually traced or impressed on the organ on which they are formed, since they evidently have a memory, and when asleep may often be seen dreaming, that is, experiencing involuntary recurrences of their ideas.

As regards the signs, so necessary for the communication of ideas, and so useful for increasing their number, I am compelled to confine myself to a simple explanation, with reference to the double service that they render us.

"Condillac," said M. Richerand, "has acquired an immortal glory, in being the first to discover and to prove irrefutably that signs are as necessary to the formation as to the expression of ideas."

I am sorry that the limits of the present work do not permit me to enter into the detail necessary for showing that there is an obvious error in a use of terms which suggests that signs are necessary to the direct formation of ideas ; for this cannot have the slightest foundation.

I do not yield to M. Richerand in admiration of the genius and the profound thoughts and discoveries of Condillac, but I am quite convinced that the signs which have to be used for the communication of ideas are generally only necessary to their formation, because they furnish an indispensable means for increasing their number and not because they actually contribute to their formation.

No doubt a language is as useful for thinking as for talking ; we have to

attach conventional signs to the conceptions we acquire, in order that these conceptions may not remain isolated, but may be associated and compared, and their relationships determined. But these signs are artificial aids, infinitely useful in helping us to think, and not immediate causes of formation of ideas.

Signs of whatever kind do no more than assist our recollection of conceptions acquired recently or long ago, furnish us means of bringing them back into consciousness, and thereby facilitate the formation of new ideas.

Condillac has successfully proved that without signs man could never have extended his ideas as he has done and still does ; but it does not follow that signs are themselves elements in ideas.

I greatly regret that I cannot continue the important discussion which this subject demands ; but probably some one will see the mistake to which I have drawn attention, and furnish a complete proof of it. Then while recognising all that we owe to the art of signs, we shall recognise at the same time that it is only an art and consequently outside nature.

From the observations and considerations set forth in this chapter I conclude :

1. That the various acts of the understanding require a special organ or system of organs, just as one is required for feeling, another for movement, and a third for respiration, etc. ;

2. That in the performance of acts of intelligence the movement of the nervous fluid is the only active factor, while the organ remains passive though contributing to the diversity of the operations by a corresponding diversity of its parts and of the impressions preserved upon them ;—a diversity that cannot be calculated since it increases up to infinity according as the organ is used ;

3. That acquired ideas are the material of all operations of the understanding ; that with this material the individual who habitually exerts his intellect may be continually forming new ideas, and that the only means open to him for this extension of his ideas consists in the art of signs to assist his memory, an art which man alone can use, which he makes more perfect every day, and without which his ideas would inevitably remain very limited.

To throw further light on the subject under discussion, I shall now pass to an examination of the principal acts of the understanding, that is to say, those of the first order from which all the rest are derived.

CHAPTER VIII.

OF THE PRINCIPAL ACTS OF THE UNDERSTANDING, OR THOSE OF THE FIRST ORDER FROM WHICH ALL THE REST ARE DERIVED.

THE subjects which I propose to treat in the present chapter are so vast as to make it impossible for me, within the limits which I have set myself, to exhaust all the problems and topics of interest which they present. I shall therefore confine myself to an attempt to show how all the acts of the understanding, and all the phenomena that result from them, originate in the physical causes which I have expounded in the previous chapter.

The special organ which gives rise to the wonderful phenomena of intelligence is not limited to a single function ; it clearly performs four essential functions ; and in proportion to its development, these functions acquire more capacity and energy, or are subdivided into many others ; so that when the organ is highly developed the intellectual faculties are numerous and some of them attain an almost infinite capacity.

Hence man, who alone furnishes instances of this latter event, is the only kind of being who is enabled by his lofty intellectual faculties to give himself up to the study of nature, to perceive and wonder at the invariable order, even to discover some of her laws, and finally to ascend in thought to the Supreme Author of all things.

The principal functions performed in the organ of intelligence are four in number, and consequently give rise to four very different kinds of acts, viz. :

1. The act which constitutes attention ;
2. That which gives rise to thought, from which spring complex ideas of all orders ;
3. That which recalls acquired ideas and is named recollection or memory ;
4. Lastly, that which constitutes judgments.

We shall enquire therefore what really are the acts of the understanding which constitute attention, thought, memory, and judgments. We shall find that these four acts are the principal ones, the type or source of all the rest, and that it is wrong to place in the first rank *will*, which is only a result of certain judgments, *desire* which is only a moral need, and *sensations* which have nothing to do with intellect.

In saying that desire is only a need or the consequence of a need that is felt, I rely on the fact that needs may be divided into physical needs and moral needs.

Physical needs are those which arise in consequence of some sensation, such as those for escaping from pain or discomfort and for satisfying hunger, thirst, etc.

Moral needs are those which arise from thoughts, and in which sensations have no share, such as those for seeking pleasure or comfort, of fleeing from danger, of indulging one's interests or vanity, or any passion or inclination, etc., etc.; desire is of this order.

Both these kinds of needs arouse the individual's inner feeling in proportion as he feels them, and this feeling promptly sets in movement the nervous fluid so as to produce actions, either physical or moral, suitable for satisfying them.

Let us now examine each of the faculties of the first order which when combined constitute the understanding or intellect.

OF ATTENTION.

THE FIRST OF THE PRINCIPAL FACULTIES OF THE INTELLECT.

I now come to one of the most important subjects of study for understanding how ideas and all intellectual acts come to be formed, and how they result exclusively from physical causes; I refer to *attention*.

Let us then enquire what attention is, and whether the definition of it that I am about to give is confirmed by the known facts.

Attention is a special act of the inner feeling; it takes place in the organ of intelligence and enables that organ to carry out its functions, for which indeed it is indispensable. Attention is therefore not in itself an operation of the intelligence but of the inner feeling, and prepares the organ of thought or some part of it for carrying out its acts.

It may be described as an effort of an individual's inner feeling, sometimes prompted by a need arising in consequence of some sensation, and sometimes by a desire called up by the memory of an idea or thought. This effort, by transporting and directing the available part of the nervous fluid towards the organ of intelligence, prepares

some part of that organ, so that it is ready either to re-awake ideas already impressed upon it or to receive the impression of new ideas.

It seems to me manifest that attention is not a sensation, as Senator Garat has said,¹ and that it is not an idea, or any operation upon ideas; consequently that it is not an act of will, since this is always the result of a judgment; but that it is an act of the individual's inner feeling, by which some part of the organ of understanding is prepared for an intellectual operation, and by which that part becomes fitted to receive impressions of new ideas, or recall to the individual ideas which had previously been traced.

Indeed I can prove that when the organ of understanding is not prepared by that effort of the inner feeling called attention, no sensation can arise; or if one does arise, it leaves no impression but merely skims over the organ without producing any idea, or recalling to consciousness any that had been previously traced.

I was justified in the statement that although every idea is derived in the first instance from a sensation, every sensation does not necessarily yield an idea. The citation of certain well-established facts will suffice to justify this proposition.

When you are reflecting, or your thoughts are occupied with something, although your eyes are open and external objects are constantly affecting your vision by the light which they emit, you do not see any of these objects or at least you do not distinguish them, because the effort of your attention guides the available portion of your nervous fluid over the outlines of the ideas which are occupying you, and because the part of your intellectual organ that is adapted to the reception of sensations of external objects is not at the time prepared to receive these sensations. Thus the external objects which affect your senses from all sides produce no idea within you.

The fact that your attention is directed to the other points of your organ, where the ideas that occupy you are traced, and where perhaps you are still tracing new and complex ones by your reflections, puts these other points in the state of tension or preparation necessary for the working of your thoughts. Hence, under these circumstances, although your eyes are open and receive the impression of external objects, yet you form no idea of them, because the sensations ensuing from them cannot penetrate to your organ of intelligence, which is not prepared to receive them. In the same way you do not hear, or at least do not distinguish, the sounds which strike your ear.

Finally, if somebody speaks to you, although distinctly and in a loud voice, at a moment when you are engrossed in some particular

¹ Course of lectures on the analysis of the understanding for the *École normale*, p 145.

subject, you hear everything and yet grasp nothing, and you are entirely ignorant what has been said because your organ was not prepared by attention to receive the ideas communicated to you.

How often it happens that we read an entire page of a work, when thinking of something different from what we are reading, and without taking in anything of what we have completely read. To this state of intellectual preoccupation is given the name of *distraction*.

But if your inner feeling, on being aroused by some need or interest, suddenly causes your nervous fluid to flow towards the point of your intellectual organ that corresponds to the sensation of some object before your eyes, or some sound that affects your ear, or some body that you are teaching, your attention then prepares this point of your organ to receive the sensation of the object in question and you immediately acquire some idea of that object; if you pay it enough attention, you even acquire all the ideas that its shape, size, and other qualities can impress on you through the medium of the various sensations.

It is, then, only *noticed sensations*, that is, those which arrest attention, that give rise to ideas: thus every idea of whatever kind is the real produce of a noticed sensation, or of an act which prepares the intellectual organ to receive the characteristic outlines of that idea; and every sensation, that is not noticed, but finds the organ of intelligence unprepared by attention, fails to form any idea.

Mammals have the same senses as man and, like him, receive sensations of whatever affects them. But since they do not dwell on most of these sensations, nor fix their attention upon them, but only notice those that are immediately related to their usual needs, these animals have but a small number of ideas, which are always more or less the same with little or no variation.

Hence except for objects which may satisfy their needs and give rise to ideas in them through being noticed, everything else is non-existent for these animals.

Nature offers to the eyes of the dog or cat, horse or bear, etc., nothing that is wonderful, curious, or interesting, but only what ministers directly to their needs or comfort; these animals see everything else without noticing it, that is to say without fixing their attention on it; consequently they can acquire no idea of it. Nor could this be otherwise so long as circumstances do not compel the animal to vary its intellectual acts, to develop the organ which produces them, and to acquire by necessity ideas different from those that their usual needs produce. The results of the education forced upon certain animals are well known.

I am therefore justified in the statement that these animals distinguish scarcely anything of what they perceive, and that everything

that they do not notice is for them non-existent, although most of the surrounding objects act upon their senses.

How great is the light thus thrown over the question why animals which possess the same senses as man have yet so few ideas, think so little, and are always subjected to the same habits!

Shall I go on to say how many men there are also who remain unconscious of nearly all that nature presents to their senses? Now in consequence of this method of employing their faculties, and limiting their attention to a small number of objects that interests them, these men only exert their intellects very little, make small variation in the subjects of their thoughts, have very few ideas, like the animals that we have spoken of, and are strongly subjected to the force of habit.

In the case of men who have not been compelled by early education to exert their intellects, the needs are confined to what they think necessary for their preservation and physical well-being, but are extremely limited as regards their moral well-being. The ideas which they form are almost entirely reduced to ideas of self-interest, property, and a few physical enjoyments; their whole attention is absorbed by the few subjects which promote the satisfaction of these needs. Whatever is irrelevant to the physical needs of such a man, to his ideas of self-interest, and his very limited physical and moral enjoyments, is as good as non-existent for him, since he never does nor can notice it, having acquired no habit of varying his thoughts.

Finally education, which so wonderfully develops the human intellect, only achieves this result by imbuing a habit of thinking and of fixing attention on the numerous and varied objects which may affect the senses, on all that can increase his physical and moral well-being, and, consequently, on the true aspects of men's relations with one another.

By fixing attention on the various objects which may affect our senses, we establish distinctions between these objects and determine their differences, affinities, and individual qualities: hence the origin of the physical and natural sciences.

In the same way, by fixing attention on the interests of men in relation to one another, we form moral ideas both as to right conduct in the situations that arise in the course of social life, and as to the progress of useful knowledge: hence the origin of the political and moral sciences.

Education thus inculcates a habit of exciting the intellect and varying the thoughts, and this greatly increases the power of giving attention to numerous different objects, of forming comparisons, of carrying out judgments with a high degree of accuracy, and of multiplying ideas of every kind, but especially complex ideas. Lastly, this habit of

exerting the intellect, when the circumstances of life are favourable, enables a man to extend his knowledge, to enlarge and guide his genius, in short, to see things on a large scale, to embrace in thought almost an infinity of objects, and to obtain from the intellect the most solid and permanent enjoyments.

I shall conclude this subject with the remark that although the attention works only by means of the individual's inner feeling when aroused by a need, usually a moral need, it is nevertheless one of the essential faculties of the intellect, and is only carried on in the organ which produces these faculties. Hence there is justification for the belief that no being which is destitute of this organ could give attention to any object.

This section on attention might well be extended, for the subject seems to me very important to investigate, and I am firmly convinced that without a knowledge of the necessary condition under which a sensation can produce an idea, we should never have been able to grasp the matters connected with the formation of ideas, thoughts, judgments, etc., nor the cause why most animals which have the same senses as man only form very few ideas, vary them with difficulty, and are dominated by the influence of habit.

There is therefore good ground for the belief that no operation of the organ of the understanding can take place unless the organ is prepared by attention; and that our ideas, thoughts, judgments, and reasonings, only continue so long as the organ, in which they are carried on, is maintained in a proper condition for producing them.

Since the nervous fluid is the chief instrument in an act of attention, a certain quantity of it is consumed when that act is in progress. Now if it lasts too long, the individual becomes so fatigued and exhausted, that the other functions of his organs suffer proportionally. Hence men who think much, and are constantly meditating, and have acquired the habit of straining their attention almost incessantly on things that interest them are much enfeebled in their digestive faculties and muscular power.

Let us now pass on to an examination of thought, the second of the principal intellectual faculties, though the earliest and most universal of its operations.

OF THOUGHT.

THE SECOND OF THE PRINCIPAL FACULTIES OF THE INTELLECT.

Thought is the most universal of intellectual acts, for if we exclude attention, which is the condition of thought, and the other acts of the understanding, thought really embraces all the rest and yet deserves to be especially distinguished.

Thought must be regarded as an action carried out in the organ of intelligence by movements of the nervous fluid. It works on ideas already acquired, either by restoring them unchanged to the consciousness of the individual, as in *memory*; or by comparing some of these ideas together so as to draw judgments from them, or to ascertain their relations, which are also judgments, as in *reasoning*; or by methodically dividing and decomposing them as in *analysis*; or lastly, in creating new ideas on the model of the old, or in contrast to them, and thence new ideas again, as in the operations of the *imagination*.

Is every thought either an act of memory or a judgment? I at first thought so; in that case thought would not be a special intellectual faculty, distinct from recollections and judgments. I believe, however, that we should classify this act of the understanding as one of its special primary faculties, for the thought which constitutes *reflection* and consists in the inspection or examination of an object, is more than an act of memory and yet is not a judgment. Indeed comparisons and investigations of relations between ideas are not mere recollections, nor are they judgments, although these thoughts nearly always terminate in one or more judgments.

Although all acts of the understanding are thoughts, we may yet regard thought itself as the result of a special intellectual faculty, since some of its acts cannot be ranked either as memory or judgments.

If it is true that all intellectual operations are thoughts, it is also true that ideas are the raw material of these operations and that the nervous fluid is the sole agent which gives immediate rise to them, as I have already explained in the previous chapter.

Thought, being an operation of the understanding wrought on previously acquired ideas, can alone give rise to judgments, reasonings, and acts of the imagination. In all this, ideas are the raw material of the operation and the inner feeling is always the stimulating and controlling cause, for it sets the nervous fluid in motion in the hypococephalon.

This act of understanding is sometimes produced as a result of some sensation, which gives rise to an idea and thence to a desire; but it is usually carried out without any immediately preceding sensation, for the recollection of an idea, giving rise to a moral need, is enough to stir the inner feeling and incite it to stimulate the act.

The organ of intelligence thus sometimes carries out its functions as a result of an external cause, which evokes some idea and stirs the individual's inner feeling; while sometimes the organ enters into activity of its own accord, as when some idea recalled by memory gives rise to a desire, that is, to a moral need, and subsequently to an

emotion of the inner feeling which leads it to produce some act of intelligence or several such acts in succession.

As in every other bodily activity, thought is achieved only by an excitation of the inner feeling, so that, except for organic movements essential to the preservation of life, acts of intelligence and those of the muscular system are always excited by the individual's inner feeling and should really be regarded as the product of that feeling.

Seeing that thought is an action, it follows that it can only be carried out when the inner feeling excites the nervous fluid of the hypocephalon to produce it, and that, considering the passive condition of the cerebral pulp, the fluid in question must be the only active body that takes a share in this action.

Since a being, endowed with an organ of intelligence, has the faculty of setting its nervous fluid in motion, and of guiding that fluid over the impressed outlines of some previously acquired idea, such a being immediately becomes conscious of this idea when the action is excited. Now this act is a thought, although a very simple one, and it is at the same time an act of memory. But if, instead of recalling a single idea, the individual recalls several, and carries out operations on these ideas, he then forms thoughts less simple and more prolonged, and he can thus carry out various intellectual acts and indeed a long succession of such acts.

Thought is therefore an action, which may be complicated by a great many others of the same kind carried out successively or sometimes almost simultaneously; it may also embrace a large number of ideas of all kinds.

Not only do the operations of thought include ideas already in existence or traced in the organ, but they may also produce ideas which did not previously exist. The results of comparisons, the relations ascertained between different ideas, and, lastly, the products of the imagination, are so many new ideas for the individual; they are generated by his thought, impressed on his organ, and subsequently transferred to his inner feeling.

Judgments, for example, which are also called inferences, because they result from comparisons or calculations, consist both of thoughts and of acts subsequent to thoughts.

The same thing holds good with regard to arguments, for we know that several judgments drawn in turn from compared ideas constitute what we call an argument; now arguments, being only series of inferences, likewise consist of thoughts and of acts subsequent to thoughts.

It follows from all this that no creature which is destitute of ideas could carry out any thought or judgment, and still less any argument.

To meditate is to carry out a succession of thoughts, to sift by successive thoughts either the affinities between several objects that are under consideration, or the different ideas that may be obtained from a single object.

A single object may indeed provide an intelligent being with a number of different ideas, such as those of its mass, size, shape, colour, consistency, etc.

If the individual becomes conscious of some of these ideas when the object is not present, he is said to be thinking of that object; and indeed he actually does carry out one or more successive thoughts with regard to it; but if the object is present he is then said to observe it and examine it, in order to derive from it all the ideas that his method of observation and capacity for attention permit of.

Just as thought works on direct ideas, that is, on ideas obtained by sensations that are noticed, so too it works on the complex ideas that the individual possesses, and may restore them to consciousness.

Hence the object of a thought or succession of thoughts may be material or include various material objects; but it may also be constituted out of a complex idea or several ideas of this character. Now, by means of thought, the individual may obtain still further ideas from these two different kinds, and so on indefinitely. Hence we get *imagination*, which originates in the habit of thinking and forming complex ideas, and which creates by similarity or analogy special ideas on the model of those yielded by sensations.

I shall now bring my remarks on this subject to a close: for I do not propose to undertake any analysis of ideas, as has already been done by abler men and more profound thinkers; I shall have attained my purpose if I have made clear the true mechanism by which ideas and thoughts are formed in the organ of intelligence, in response to excitations of the individual's inner feeling.

I shall merely add that thought is always accompanied by attention, so that when the latter ceases the former promptly comes to an end.

I shall further add that since thought is an action, it uses up the nervous fluid, and consequently, that when it is maintained too long, it causes fatigue, exhaustion and injury to all the other organic functions and especially that of digestion.

I shall conclude with the following remark, which I believe to be well-founded, viz.: that the available portion of our nervous fluid becomes larger or smaller in accordance with certain conditions, so that it is sometimes abundant and more than sufficient for the production of prolonged thought and attention, while sometimes it is sufficient and cannot provide for a succession of intellectual acts,

except at the expense of the functions of the other organs of the body.

Hence those rises and falls in the activity of thought noted by Cabanis; hence that facility at certain times and difficulty at other times of fixing attention and following out a line of thought.

In one who is weakened as a result of disease or age, the functions of the stomach are carried out with difficulty, and use up a large part of the available nervous fluid. Now if during this labour of the stomach you divert nervous fluid from the digestion towards the hypocephalon, if, that is to say, you give yourself up to close study and a succession of thoughts which require profound and continued attention, you damage your digestion and endanger your health.

In the evening, when one is more or less exhausted by the various fatigues of the day, especially when one is no longer in the vigour of youth, the available portion of the nervous fluid is generally less abundant and less fitted to provide for continued thought: in the morning, on the contrary, after the recuperation of a good sleep, the available portion of the nervous fluid is very abundant, and can adequately meet the demands that are made upon it by intellectual operations or bodily exercises. Finally, the more you consume of your nervous fluid that is available for intellectual operations, the smaller is your capacity for bodily labour and exercise, and *vice versa*.

In consequence of these causes and many others, there are remarkable fluctuations in our faculty for following a line of thought, meditating, reasoning, and especially exerting our imagination. Among these causes, variations in our physical condition and the influence upon it of atmospheric changes are not the least powerful.

Since acts of imagination are at the same time thoughts, this is the right place to speak of them.

IMAGINATION.

The imagination is that faculty for creating new ideas that the organ of intelligence acquires by means of its thoughts. It is dependent on the presence of many ideas, out of which new complex ideas are constantly being formed.

The intellectual operations, which give rise to acts of the imagination, are excited by the individual's inner feeling, carried out like other acts of thought by the movements of his nervous fluid, and controlled by judgments.

Acts of imagination consist in creating new ideas by comparisons and judgments of previous ideas, these being taken either as models or as contrasts; so that with this material the individual can form

for himself a number of new ideas which are impressed on his organ, and out of these many more again, with no limit to this infinite creation beyond that suggested by his endowment of reason.

I have said that the previously acquired ideas which furnish the material for acts of the imagination are employed in these acts either as models or as contrasts.

In fact, if we consider all the ideas produced by human imagination, we shall see that some, including the larger number, are modelled on simple ideas which have arisen immediately from sensations, or on complex ideas based upon the simple ideas, and that the rest originate in contrast or opposition to the simple or complex ideas that had been acquired.

Since man cannot form any true idea, except of objects or things in the likeness of objects, his intellect would have been limited to the elaboration of this one kind of idea, if it had not possessed the faculty of taking these ideas either as models or contrasts, and forming from them ideas of another kind.

It is by contrast to simple or complex ideas, that man imagined the infinite, basing it on his idea of the finite; when he had conceived the idea of a limited duration, he imagined eternity or an unlimited duration; when he had formed the idea of a body or of matter, he imagined mind or an immaterial being, etc., etc.

It is not necessary to show that every product of the imagination, which does not present a contrast to some simple or complex ideas originally acquired through sensations, is necessarily modelled upon some such idea. How many citations I might make, if I wished to show that wherever man has tried to create ideas, his materials have always been in the likeness of previously acquired ideas or in contrast to them!

It is a truth borne out by observation and experience, that the intellectual organ is in the same case as all the other bodily organs; the more it is exercised the more it develops and the more its faculties extend.

Those animals, which are endowed with an intellectual organ, nevertheless lack imagination, because they have few needs, vary their actions but little, and hence acquire but few ideas, and especially because they rarely form complex ideas and then only of the first order.

But man, who lives in society, has so largely increased his needs that he has been obliged to increase his ideas to a corresponding extent; so that of all thinking creatures he is the one who can most easily exercise his intellect, vary his thoughts the most and, lastly, form the greatest number of complex ideas: hence we have reason to believe that he is the only creature that can have imagination.

If, on the one hand, imagination can only exist in an organ which already contains many ideas, and only originates from the habit of forming complex ideas; and if, on the other hand, it is true that the more the organ of intelligence is exercised, the more it develops, and the more its faculties extend and increase, we shall perceive that although all men might possess this fine faculty called imagination, yet there are only very few who could have it to any high degree.

How many men there are, even excluding those that have had no education, who are forced by their condition of life to occupy themselves daily during the chief part of their lives with the same kinds of ideas and to carry out the same work, and who as a result are scarcely at all able to vary their thoughts! Their habitual ideas revolve in a little circle which is nearly always the same and they make but few efforts to enlarge it, because they have no great interest in doing so.

Imagination is one of the finest faculties of man: it ennobles and elevates his thoughts and relieves him from the domination of minute details; and when it reaches a very high development, it makes him superior to the great majority of other people.

Now genius in an individual is nothing else but a high imagination, guided by exquisite taste and a well-balanced judgment, and nurtured and enlightened by a vast knowledge, and controlled in short by a high degree of reason.

What would literature be without imagination! It is useless for the man of letters to be a perfect master of his language; it is useless for him to cultivate a purified diction and faultless style; if he has no imagination, he is cold, lacks thought and images, rouses no emotion or interest, and all his efforts are futile.

How could poetry, that beautiful branch of literature, and how even could rhetoric dispense with imagination?

For myself, I hold that literature, that beautiful produce of the human intellect, is the noble and sublime art of arousing our passions, elevating and widening our thoughts, and transporting them out of their usual routine. This art has its rules and precepts, but imagination and taste are the exclusive source of its finest products.

Since literature arouses, animates, and charms every man who is able to appreciate it, science is to that extent inferior; for she teaches coldly and stiffly: but science is superior in this, that not only does she serve all the arts and furnish us with the best means of providing for all our physical needs, but that she also greatly broadens our thoughts by showing us everywhere what is really there and not what we want to find there.

The purpose of the former is to give pleasure; that of the latter is to collect all practicable positive knowledge.

This being so, imagination is as much to be feared in the sciences as it is indispensable in literature; for its aberrations in the latter are merely a lack of taste and reason, whereas its aberrations in the former are errors; for the imagination nearly always gives rise to errors, when it is not controlled and limited by learning and reason; and if these errors are captivating, they inflict upon science an injury which is often very difficult to repair.

Yet without imagination there is no genius, and without genius there is no possibility of discovering anything but facts, without drawing any satisfying inferences. Now since every science is a body of principles and inferences carefully deduced from observed facts, genius is absolutely necessary for stating these principles and drawing their inferences; but it has to be guided by a sound judgment, and kept within the limits imposed by a high degree of enlightenment.

Thus, although it is true that imagination is to be feared in the sciences, this only holds good when it is not controlled by a lofty and enlightened reason; when it is so controlled, it is one of the essential factors in the progress of science.

Now the only means of limiting our imagination, so that its aberrations may not affect the advancement of knowledge, is to allow it to work only on real natural objects; since such objects are all that we can possibly know positively; its various acts will then possess a reliability that is proportional to the number of facts considered in the object concerned, and to the excellence of our judgment.

I shall conclude this section with the remark that if it is true that we derive all our ideas from nature, and have none that do not come originally from her, it is also true that we can modify these ideas in various ways by means of our imagination, so as to create new ones entirely foreign to nature; but these latter are always either contrasts to acquired ideas, or else more or less distorted images of objects the knowledge of which we derive from nature alone.

Even in the most exaggerated and extraordinary ideas of man, it is impossible not to recognise their origin, by means of a close examination.

OF MEMORY.

THE THIRD OF THE PRINCIPAL FACULTIES OF THE INTELLECT.

Memory is a faculty of the intellectual organs; the recollection of an object or thought is an act of this faculty; and the organ of the understanding is the seat where this wonderful act occurs, while the nervous fluid by its movements in that organ is the sole agent of its occurrence.

This I propose to prove ; but first let us consider the importance of the faculty in question.

Memory may be described as the most important and necessary of the intellectual faculties, for without memory what could we do ? how could we provide for our various needs, if we could not recall the different objects, that we have come to know or to use for their satisfaction ?

Without memory, man would have no kind of knowledge ; he would be absolutely destitute of science ; he could cultivate no art ; he could not even have a language for the expression of his ideas ; and seeing that, in order to think or even to imagine, he must, in the first place, have ideas and, in the second place, institute comparisons between these ideas, he would be altogether deprived of the faculty of thought and imagination if he had no memory. When the ancients said that the muses were daughters of memory, they proved that they were conscious of the importance of this intellectual faculty.

We saw in the preceding chapter that ideas spring from sensations which we have experienced and noticed, and that with the ideas thus impressed upon our organ we can form others which are indirect and complex. Since the time of Locke, it has been recognised that all ideas whatever originate from sensations and that none have any other origin.

We shall now see that memory can only come into existence after ideas have been acquired, and consequently that no individual could display any act of memory unless he had ideas impressed on the organ which is the seat of it.

If this is so, nature can have given to the most perfect animals and even to man nothing but memory ; she cannot give prescience, that is to say, a knowledge of future events.¹

Man would no doubt be very unhappy, if he knew definitely what was going to happen to him, the precise date of the end of his life, etc., but the real reason why he has not this knowledge is that nature could not give it to him ; it was impossible for her. Seeing that memory is only the recollection of past events, of which we were able to form ideas, and seeing that the future will give rise to events which do not yet exist, we cannot form any idea of it, except in the case of such facts as belong to certain ascertained parts of the order followed by nature.

¹ With regard to future events, those which flow from comparatively simple causes and from the laws which man has discovered in his studies of nature, are capable of being foreseen by him, and up to a certain point of being referred in advance to more or less definite dates. Thus astronomers can prophesy the future date of an eclipse, or when some star will be in some particular position ; but this foreknowledge of certain facts is confined to a very small number of objects. Yet many other future events of a different kind are also known to him : for he knows that they will occur without being able to specify precisely when.

Let us now enquire what the mechanism of this wonderful faculty may be ; I shall endeavour to show that the operation of the nervous fluid, which gives rise to an act of memory, consists in the acquisition of a special movement by that fluid as it passes over the impressions of some acquired idea, and in the transference of that movement to the individual's inner feeling.

Since ideas are the material of all intellectual acts, memory presupposes ideas already acquired ; and it is obvious that an individual who had never had an idea could not possess any memory. Hence the faculty called memory only begins to exist in an individual who possesses ideas.

Memory throws light on the nature of ideas, and even suggests the answer to the question as to what they really are.

Now I have pointed out that the ideas which we have formed through the medium of sensations, and those that we have acquired later by means of thought, consist of specific images or outlines graven or impressed more or less deeply on some part of our organ of intelligence. These ideas are recalled by memory, whenever our nervous fluid, aroused by our inner feeling, comes in contact with their images or outlines. The nervous fluid then transmits the effects to our inner feeling and we immediately become conscious of these ideas : that is how acts of memory take place.

The inner feeling, which controls the movement of the nervous fluid, may direct it over one only of the previously traced ideas or over several of them ; hence memory may recall one idea alone, or several ideas in succession, according to the individual's desire.

It follows from the above that if our ideas, both simple and complex, were not impressed more or less deeply on our organ of intelligence, we should be unable to recall them and memory could not therefore exist.

Suppose that some object strikes our attention, a fine building, for instance, which has caught fire and is being burnt up before our eyes. Now for some time after, we can recall that object perfectly without seeing it ; for this purpose an act of thought is quite sufficient.

This process must be due to the fact that our inner feeling sets our nervous fluid in motion, and drives it into our organ of intelligence over the outlines impressed by the sensation of the conflagration ; and that the modification, acquired by our nervous fluid in its movements as it passes over these particular outlines, is promptly transmitted to our inner feeling and thereupon restores to clear consciousness the idea that we are seeking to recall ; although the idea is less vivid than when the conflagration was actually taking place before our eyes.

We likewise recall any person or object that we have previously seen and noticed; and in the same way we recall complex ideas that we have acquired.

Our ideas, then, are specific images or outlines impressed on some part of our organ of intelligence, and we only become conscious of these ideas when our nervous fluid is set in motion and transmits to our inner feeling that modification of its movement which it acquired while passing over these outlines. So true is this, that if during sleep our stomach is disordered or we suffer from some internal irritation, our nervous fluid acquires an agitation which is propagated into our brain. It is easy to conceive how this fluid, when its movements are no longer controlled by our inner feeling, follows no order in passing over the outlines of the various ideas impressed upon it, but brings them into consciousness in the greatest confusion, usually distorting them by strange associations and unbalanced judgments.

During perfect sleep, the inner feeling undergoes no emotion, and for practical purposes ceases to exist; consequently it no longer controls the movements of the available portion of the nervous fluid. Thus a sleeping individual is as though he did not exist. He no longer possesses feeling, although the faculty of it is intact; he no longer thinks, although he still has the power to do so; the available portion of his nervous fluid is in a state of rest, and since the factor which produces actions (the inner feeling) is no longer active, the individual also can do nothing.

But if sleep is imperfect, owing to some internal irritation which stimulates an agitation of the free part of the nervous fluid, the movements of the latter are not controlled by the inner feeling; they therefore occasion disordered ideas and strange and motley thoughts, owing to the haphazard association of ideas that have no relation to one another. Thus are formed the various dreams which we have, when our sleep is not perfect.

These dreams, or the disordered ideas and thoughts which constitute them, are nothing but acts of memory occurring at random and in confusion; they are irregular movements of the nervous fluid in the brain, whereby consciousness is filled with disconnected ideas, since the inner feeling no longer exerts its functions during sleep nor guides the movements of the nervous fluid.

This is why we have dreams when digestion is very difficult, or when we have been much agitated by some great interest or by objects which have stirred us. These produce during sleep a great agitation of our spirits, that is, of our nervous fluid.

Now these disordered acts are always wrought upon ideas that have been acquired and impressed on the organ of intelligence: an individual

could never have an idea in a dream, that he had not had when awake, nor recall an object of which he was previously ignorant.

If someone were to be confined from his childhood in a room where daylight was only admitted from above, and if all necessaries were supplied to him without communication, he would assuredly never see in his dreams any of those objects which affect men so strongly in society.

Thus dreams disclose to us the mechanism of memory, just as memory teaches us the mechanism of ideas; when I see my dog dreaming, barking in his sleep, and giving unequivocal signs of the thoughts which agitate him, I become convinced that he too has ideas, of however limited a kind.

It is not only during sleep that the functions of the inner feeling may be suspended or disturbed. While we are awake, a sudden strong emotion sometimes suspends altogether the functions of this feeling, and even all movement in the free part of the nervous fluid; we then suffer from syncope, that is to say, we lose all consciousness and power of action; sometimes also an extensive irritation, such as occurs in certain fevers, similarly suspends the functions of the inner feeling and yet agitates the free portion of the nervous fluid in such a way as to call up disordered ideas and thoughts, and lead to actions no less disordered: in such a case we suffer from what is called delirium.

Delirium therefore resembles dreams as regards the disorder of ideas, thoughts and judgments, and it is clear that this disorder in both cases arises from the fact that the functions of the inner feeling are suspended, so that it no longer controls the movements of the nervous fluid.¹

But the violence of the nervous agitation causing delirium is the reason for believing that this phenomenon is not only the product of a strong irritation, but sometimes also of a powerful moral affection; so that individuals experiencing it then obtain very little advantage from their knowledge, for their inner feeling, whose functions are disturbed and suspended, no longer guides the nervous fluid in a way suitable for correct ideas.

Indeed, when moral sensibility is very great, the emotions produced in the inner feeling by certain ideas or thoughts are sometimes so considerable, that the functions of this feeling are disturbed, and it is unable to guide the nervous fluid towards the performance of the new

¹ With regard to the faint delirium or kind of dizziness, commonly experienced when we are falling off to sleep, it is probably due to the fact that the inner feeling, which is losing control of the movements still taking place in the nervous fluid, resumes and again gives up that control several times alternately, until complete sleep has supervened.

thoughts which ought to be produced ; the intellectual faculties are then suspended or in disorder.

We shall see that lunacy is also due to a very similar cause, which prevents the inner feeling from directing the movements of the nervous fluid into the hypocephalon.

In fact, when any accidental injury has caused some disturbance in the organ of intellect, or when a powerful emotion of the inner feeling has left upon this organ traces deep enough to produce some degeneration in it, the inner feeling no longer controls the movements of the nervous fluid in that organ, and the ideas raised in the individual by the agitations of the fluid present themselves without any order or connection. He gives expression to whatever occurs to him, and his actions are of a corresponding kind. But we see from the acts of this individual that he is always affected by ideas previously acquired and then brought into consciousness. In point of fact memory, dreams, delirium, acts of lunacy, never bring out any ideas beyond those already possessed by the individual.

There are some acts of lunacy which follow from a disorder of certain special organs of the hypocephalon, while the others maintain their integrity ; it is then only in these special organs that the inner feeling cannot control or direct the movements of the nervous fluid. People who are affected in this way only perform acts of lunacy with regard to certain subjects that never vary : they appear to be in possession of their reason on all other subjects.

I should travel beyond my province if I tried to follow all the distinctions observed in the disorder of ideas, and to ascertain their causes. It is enough to have shown that dreams, delirium, and lunacy in general are only disordered acts of memory which always work upon ideas previously acquired and impressed on the organs, but which are beyond the control of the individual's inner feeling, because the functions of this power are suspended or disturbed, or because the state of the hypocephalon does not permit of their performance.

Cabanis had no idea of the strength of the inner feeling, nor did he perceive that this feeling constitutes in us a power that can be stirred by any need, or by the smallest desire, or by a thought, and that it is then able to set in motion the free portion of the nervous fluid and to direct its movements either into our organ of intelligence, or towards muscles which require to be actuated. Yet he was forced to recognise that the nervous system often enters into activity of its own accord, without the stimulus of external impressions, and that it can even disregard these impressions and escape from their influence, since concentrated attention or deep thought suspend the activity of the external organs of feeling.

"It is thus," said Cabanis, "that operations of imagination and memory are performed. The motions of the objects recalled and represented are, it is true, usually provided by impressions received in the various organs : but the act which recalls their image, which presents them to the brain in their correct form, which puts that organ in a condition to form numberless new combinations, often depends entirely on causes situated within the sensitive organ." (*Histoire des Sensations*, p. 168.)

This appears to me quite true ; it is all the result of the power of the inner feeling of the individual, for this feeling can be aroused by a simple idea which gives rise to that moral need called desire ; and we know that desire includes and leads to the performance both of those actions which set up muscular movement, and of those which give rise to our thoughts, judgments, reasonings, philosophical analyses, and to the operations of our imagination.

Desire creates the will to act in one or other of these two ways : now this desire, together with the will which it evokes, arouses our inner feeling, so that it dispatches nervous fluid either into some part of the muscular system, or of the organ which produces acts of intelligence.

If Cabanis, whose work on the *Rapports du Physique et du Moral* is an inexhaustible mine of observations and interesting discussion, had recognised the power of the inner feeling ; if he had guessed the mechanism of sensations, and not mistaken physical sensibility for the cause of intellectual operations ; if he had recognised that sensations do not necessarily yield ideas, but mere perceptions, which is a very different thing ; if, lastly, he had distinguished what is due to irritability from what is the product of sensations ; how great would have been the light which his interesting work might have shed ! As it is, this work presents the best means for advancing that sphere of human knowledge now in question, on account of the multitude of facts and observations which it comprises. But I am convinced that these facts can only be made useful by fixing our ideas on the essential distinctions drawn in the course of the present work.

By paying attention to what I have said in the present section, we shall probably reach the conviction :

1. That the seat of memory is the organ of intelligence itself, and that the operations of memory are simply acts which recall to consciousness ideas already acquired ;
2. That the outlines or images of these ideas are necessarily already graven in some part of the organ of understanding ;
3. That the inner feeling, when stirred by any cause, drives the available nervous fluid over such of the impressed outlines as may be selected

by the emotion which it has derived either from a need or inclination, or from an idea which awakes a need or inclination; and that it promptly brings them into consciousness, by carrying back to the sensitive nucleus the modifications of movement which the nervous fluid has acquired from these outlines;

4. That when the functions of our inner feeling are suspended or disturbed, it ceases to direct the movements which may then set our nervous fluid in motion; so that if some cause then agitates this fluid in our intellectual organ, its movements bring back to the sensitive nucleus disordered ideas, strangely mixed and without any connection or sequence; hence dreams, delirium, etc.

We thus see that the phenomena in question everywhere result from physical acts which depend on the organisation and its condition, and on the circumstances in which the individual is placed, as well as on the variety of causes, likewise physical, which produce these organic acts.

Let us pass to an examination of the fourth and last kind of the principal operations of the intellect, viz. those operations which constitute judgments.

OF JUDGMENT.

THE FOURTH OF THE PRINCIPAL FACULTIES OF THE INTELLECT.

The operations of the intellect which constitute judgments are the most important to the individual of any that his understanding can perform; they are those which can least easily be dispensed with, and which he is most often called upon to use.

It is in this faculty of judgment that the will takes its origin; it is also this faculty which gives rise to moral needs such as desires, wishes, hopes, anxiety, fear, etc.; lastly, it is always as a result of judgments that those of our actions, in which our understanding has had some share, are performed.

We cannot carry out any series of thoughts without forming judgments; our reasonings and analyses are pure results of judgments; the imagination itself has no power, except through its judgments, with regard to the models or contrasts used in the creation of ideas; finally, any thought, which is neither a judgment nor accompanied by a judgment, is a mere act of memory or else constitutes a barren inspection or comparison.

How important it is then for every being endowed with an intellectual organ to accustom himself to use his judgment, and to endeavour gradually to improve it by means of observation and experience; for he is then exercising his understanding at the same time, and he increases its faculties to a proportional extent!

Yet if we consider the great majority of men, we find that whenever there is no pressing need or danger they rarely judge for themselves but rely on the judgments of others.

This obstacle to the progress of individual intelligence is not merely due to idleness, carelessness, or lack of means; it is due further to the habit impressed on individuals, during their childhood and youth, of believing what they are told and of always submitting their judgment to some authority.

Now that we have briefly indicated the importance of judgment, and especially of developing it by use and gradually improving it by experience, let us enquire what it is itself and by what mechanism it works.

A judgment is a very peculiar act, carried out by the nervous fluid in the intellectual organ; its result is then traced upon that organ and is immediately brought back to the individual's inner feeling; in other words, is brought into consciousness. Now this act is always the result of some comparison made, or some relation sought, between ideas previously acquired.

The following is probably the mechanism of this physical act: for it is the only mechanism which seems to me capable of giving rise to it, and is in harmony with the known effects of the law of united or combined movements.

Each idea that is graven doubtless occupies a special site in the organ: now when the nervous fluid is agitated and traverses the outlines of two different ideas at the same moment, as occurs in a comparison of two ideas, it is then necessarily divided into two separate streams, one of which passes over the first of the two ideas while the other passes over the second. In each case these two streams of nervous fluid undergo a modification of movement, which is caused by the outlines they pass over and which is peculiar to the idea in question. Hence we may imagine that, if these two streams are subsequently united into one, their movements will also be combined, so that the common stream will have a compound movement which is the resultant of the two kinds of movements brought into combination.

The physical act giving rise to a judgment is therefore probably constituted by the movements of the nervous fluid, when spread over the impressed outlines of ideas that are being compared; and it appears to consist of as many special movements of the fluid, as there are ideas compared and separate streams of fluid passing over the outlines of these ideas. Now these separate streams of the same fluid, each with its special movement, all unite to form a single stream whose movement is compounded of all the special movements named; and this compound movement then impresses new outlines on the

organ, that is to say, a new idea which is the judgment in question.

This new idea is instantly brought back to the individual's inner feeling; he has a moral feeling of it; and if it awakes in him any need, which is likewise moral, it evokes his will to act in order to satisfy it.

In addition to inexperience, and to the consequences of the almost universal habit of judging in imitation of others, numerous factors combine to affect our judgments, that is to say, to make them less well-balanced.

Some of these factors are due to an imperfection in the comparisons that are made, and to the preference given by the individual to one idea over another, according to his knowledge, special tastes, and condition; so that the true elements which should enter into the formation of these judgments are incomplete. In all ages there are but few men who are capable of profound concentration, and who, being accustomed to think and to learn from experience, can escape from these factors which tend to affect their judgments.

The others, which it is difficult to avoid, take their origin: (1) In the actual state of our organisation, which affects the sensations originating ideas; (2) in the error in which some of our sensations frequently involve us; (3) in the influence that our inclinations or passions exert on our inner feeling, leading it to give to the movements, which it impresses on our nervous fluid, a different direction from what it would have given them without that influence, etc., etc.

Since I have already treated of the judgment in Chapter VI. of this part, I should travel beyond the limits of my plan if I were to enter into the details of the numerous factors which combine to affect our judgment. It is sufficient, for the purpose that I have in view, to observe that many factors are apt to affect the value of the judgments that we form; and that in this respect there is as great a diversity in the judgments of men, as there is in their physical condition, environment, inclinations, knowledge, sex, age, etc.

Let us not be astonished then at the permanent but not universal disagreement noticed in the judgments that are passed on some thought, argument, work, or any other subject, in which no one can see anything but what he has decided for himself and what he can imagine to himself as a result of the character and extent of his knowledge; nothing, in short, but what he can understand, in accordance with the amount of attention that he pays to the subjects presented to him. How many persons there are, too, who have formed a habit of judging scarcely anything for themselves, and consequently of falling back in almost everything on the judgment of others!

These considerations, which seem to me to prove that judgments are

subject to different degrees of correctness, and that this correctness is relative to the individual's circumstances, naturally lead me to say a word about reason, to enquire what it is, and to compare it with instinct.

OF REASON.

AND ITS COMPARISON WITH INSTINCT.

Reason is not a faculty; still less is it a torch or entity of any kind; but it is a special condition of the individual's intellectual faculties; a condition that is altered by experience, gradually improves and controls the judgments, according as the individual exercises his intellect.

Reason therefore is a quality that may be possessed in different degrees, and this quality can only be recognised in a being that possesses certain intellectual faculties.

In the last analysis, it may be said that for all individuals endowed with intelligence, reason is nothing more than a stage acquired in the rectitude of judgments.

No sooner are we born than we experience sensations, mainly from external objects affecting our senses; we quickly acquire ideas, which are formed in us as a result of noticed sensations; and we soon compare almost mechanically the objects we have noticed and thus form judgments.

But we are then new to the whole of our environment, destitute of experience, and deceived by some of our senses, so that we judge badly; we are mistaken as to the distances, shapes, colours, and consistency of the objects that we notice, and we do not grasp the relations existing between them. It is necessary that several of our senses should combine gradually to destroy our errors and rectify our judgments; lastly, it is only with the help of time, experience, and attention paid to the objects which affect us, that rectitude is slowly attained in our judgments.

The same thing is true with regard to our complex ideas, and the useful truths, rules, or precepts communicated to us. It is only by means of much experience, and memory in collecting all the elements for an inference; only by means of the greatest use of our understanding, that our judgment on these matters is gradually improved.

Hence the wide difference existing between the judgments of childhood and those of youth; hence again the difference found between the judgments of a young man of twenty and those of a man of forty or more, when the intellect in both cases has always been regularly exercised.

Since the extent of our reason is proportional to the rectitude of our

judgment on all things, and especially on the ordinary affairs of life and our relations with our fellows, it follows that this quality is only a certain stage acquired in the rectitude of judgments; and seeing that environment, habit, temperament, etc., involve a great diversity in the exercise of our understanding, that is to say, in our way of thinking, investigating, and judging, it follows that there are real differences between the judgments that are formed.

Thus reason is not an individual object or entity that we may or may not possess, but it is a condition of the organ of understanding, from which results a greater or smaller degree of rectitude in the individual's judgments; so that every being who possesses an organ of understanding, who has ideas and performs judgments, must possess a certain degree of reason corresponding to his species, age, habit, and the various circumstances which combine to retard or advance or to keep stationary the progress made in rectitude of judgments.

Seeing that it is only by paying attention to the objects producing sensations in us, that these sensations can give rise to ideas, it is clear that the more we use this faculty of attention, and the deeper and more sustained it is, the clearer become our ideas, the more accurately are they defined, and the more correct are the judgments that we form from them.

Hence it follows that the highest stage of reason is that which comes from extreme clearness in the ideas, and from an almost invariable soundness of judgments.

Man, who is much more capable than any other intelligent being of this profound and continuous attention, and can fix it on a great many different objects, is the only one who can have an almost infinite variety of clear ideas and whose judgments consequently possess the highest rectitude; but for this purpose he has to exercise his intellect vigorously and perpetually, and his circumstances have to be favourable for it.

It follows from the above, that since reason is only a stage in the rectitude of judgments, and since every intelligent being can carry out judgments, they must all possess a certain degree of reason.

Indeed, if we compare the ideas and judgments of an intelligent animal, which is still young and inexperienced, with the ideas and judgments of the same animal when it has reached the age of acquired experience, we shall find that the difference between these ideas and judgments is quite as discernible in the animal as it is in man. A gradual improvement in the judgments, and an increasing clearness of the ideas, fill up in both cases the interval between the time of their childhood and that of their maturity. The age of completed experience and development is clearly distinguished from that of inexperience

and low development of the faculties in such an animal, just as it is in man. In both cases the same features are to be recognised, and an analogous progress in the acquirements; it is only a matter of more or less in the different species.

In animals possessing a special organ for intelligence, there are therefore various degrees in the rectitude of judgments and hence various degrees of reason.

Doubtless the highest degree of reason gives man a perception of the propriety or impropriety both of his own ideas and beliefs, and of the ideas and beliefs of others; but this perception, which is a judgment, is not a property of all men. Those who do not possess it substitute a false perception in place of that just perception which arises from a highly trained intellect; and, since the former is the best they can attain, they believe it to be just. Hence arises that diversity of opinions and judgments in individuals of the human species; a diversity which will always stand in the way of a real agreement between the ideas and judgments of individuals, owing to the fact that men are situated in very different circumstances and therefore cannot attain the same degree of reason.

If we now compare reason with instinct, we shall see that the former to some extent gives rise to determinations to act, originating in the intellect, that is to say, in ideas, thoughts, and judgments; whereas instinct, on the contrary, is a force which impels towards an action, without any previous determination or intellectual act.

Now, since reason is only a stage acquired in rectitude of judgments, the determinations of action which spring from it may be wrong or unsuitable when the judgments producing them are erroneous; they may be false in whole or in part.

But instinct, which is simply an impelling force and arises from the inner feeling when stirred by some need, never makes a mistake in the action to be performed; for it does not choose, nor does it result from any judgment, and there are not really different degrees of it. All action caused by instinct is therefore invariably due to the kind of excitation produced by the individual's inner feeling, just as all movement communicated to a body is made up, both in direction and strength, by the power which communicated it.

There is nothing either clear or really exact in Cabanis' idea of attributing reasoning to external sensations, and instinct to internal impressions. All our impressions are invariably internal, although the objects causing them may be either external or internal. Observation of the facts should convince us that it is more just to say:

That the reasonings and determinations, following from judgments, take their origin from intellectual operations; whereas instinct, in

causing some action, takes its origin from the needs and propensities which arouse immediately the individual's inner feeling and make him act, without any choice or deliberation, or, in short, any participation of the intellect.

The actions of certain animals are therefore sometimes based on rational determinations, but more often on an instinctive force.

If we pay attention to the facts and arguments presented in the course of the present work, we shall perceive that there must be animals which have neither reason nor instinct, such as those which are destitute of the faculty of feeling; that there must be others which have instinct but possess no degree of reason, such as those which have a sensitive system, but lack the organ for intelligence; lastly, that there must be others again which have instinct together with some degree of reason, such as those which possess a system for sensations and another for acts of the understanding. The instinct of these last is the source of nearly all their actions, and they rarely make use of such degrees of reason as they possess. Man, who comes next, also has instinct which in certain circumstances makes him act; but he is capable of acquiring much reason, and of using it to control the greater part of his activities.

Besides the *individual reason* of which I have been speaking, there is established, in every country and region of the earth, in proportion to the knowledge of the men who live there and to certain other factors, a *public reason*, which is almost universal, and which is upheld until new and sufficient causes operate to change it. In both cases, the individual and the public reason are always constituted by a certain degree of rectitude in the judgments.

It is true that in a society or nation, errors and false beliefs may be as much matters of general assent as ascertained truths; so that various errors, prejudices, and truths go to make up the degree of rectitude of judgment, both in individuals and in the received opinions of societies, groups, and nations, according to the age or period considered.

We have therefore to recognise different stages of advance in the reason of a people or society, as in that of an individual.

Men who strive in their works to push back the limits of human knowledge know well that it is not enough to discover and prove a useful truth previously unknown, but that it is necessary also to be able to propagate it and get it recognised; now both individual and public reason, when they find themselves exposed to any alteration, usually set up so great an obstacle to it, that it is often harder to secure the recognition of a truth than it is to discover it. I shall not dwell on this subject, because I know that my readers will see its implica-

tions sufficiently, if they have any experience in observation of the causes which determine the actions of mankind.

In concluding this chapter on the principal acts of the understanding, I terminate at the same time all that I propose to present to my readers in the present work.

In spite of the errors into which I may have been led, the work may possibly contain ideas and arguments that will have a certain value for the advancement of knowledge, until such time as the great subjects, with which I have ventured to deal, are treated anew by men capable of shedding further light upon them.

THE END.

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