The brain in relation to the mind / by Joseph Swan.

THE

BRAIN

IN RELATION TO

THE MIND.

By JOSEPH SWAN.

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PREFACE.

It has been the endeavour of the author to find out why there is so small a portion of the brain set apart for the uses of the organs of the several senses, and a still smaller portion for the involuntary functions; and why by far the largest amount—probably nine-tenths of the whole—has been connected with the voluntary tract, which gives origin to the voluntary nerves. Such an extensive collection of fibres, in combination with the gray matter forming the convolutions, did not appear necessary for promoting the voluntary activity of muscles only, nor even for ensuring the combinations and intricacies of their motions; it was therefore concluded that the greater portion must exist for the determination and uses of some of the intellectual powers, in connection with the

organs which formed the medium of communication between the intellect and the external world, and were necessary for the acquisition and communication of knowledge. This conclusion seemed to be strengthened by the consideration that this part is so much larger in proportion to the rest than it is in the brain of the highest animals, and that the powers of the intellect become diminished in the proportion that it holds in the descending scale of animals. This position may seem to be somewhat invalidated by the clever acts of some insects, which have very diminutive brains, and appear to observers, equal to or more wonderful than any, man is capable of; but such conclusions will be found susceptible of a different construction when they are carefully examined.

In explaining the manner in which the brain acts in conveying information from any of the organs of sense, and fixing it, a decided proof of the activity of the fibres connected with the voluntary tract, in effecting its permanent impression on the mind, is satisfactorily afforded by the evidence that every variety of knowledge is attained by

the same means, whether it consists in letters or figures, or in the mechanical arts themselves; and thus a conclusive evidence is afforded respecting the uniformity of the process employed. And further, as each portion of learning, and the completion of every mechanical operation, is generally finished by a demonstration of contractile functions, shown in the actions of the muscles either of the lips and tongue, or the hands, there seems to be a further proof of the tonic activity of the white fibres connected with both the muscles and the convolutions of the brain and their adaptation for their intended purpose.

INTRODUCTION.

ALL sensations or feelings pass from one or other of the organs of sense by their respective nerves to the sensory. Some of them are for temporary purposes, and fleeting, so as to become almost as much effaced as if they had never been received.

The large mass of white fibres tending from the convolutions to the striated body, and thence to the crus of the brain, and the pyramidal body from which all the voluntary nerves arise, constitute by far the largest portion of the entire brain. These fibres of the voluntary tract have a capability of activity, not amounting to motion like that of the muscles, but on being excited possess an energetic or tonic power; so that when a letter or a man's face is transferred to them from the eye, they can change their negative quality into a more positive

one, so as to receive the image as a correct miniature, and then conduct it by continuous fibres to join those about to pass through the striated body and crus of the brain to the nerves and muscles of the tongue for speaking, or through the spinal cord and nerves to the muscles of the hand for writing, drawing, or other mechanical device.

All impulses received from the organs of sense, which are to be accepted for constituting knowledge, are impressed by one or more fibres of the voluntary tract on the sensory conjointly with the mind, and by one or several repetitions are made permanent. All knowledge purely mental is accepted by, and becomes subjected to, the mental faculties, and may at any time be conveyed back from the mind through the voluntary tract and muscles employed in the tongue for speech, and in those of the hand for writing.

The intellect cannot accept impulses for instruction, nor plant or fix them without voluntary exertion, especially symbols, as figures and letters representing the rudiments of the arts and sciences. All knowledge, except of such things as are per-

petually required for the uses of the body, soon vanishes, unless means are taken for understanding its import, and for making fresh impressions of the same from time to time on the sensory, until it is thoroughly fixed. Objects may be conveyed by sight or hearing, or by touch, or by all of them; but, unless the will exercises its powers for imprinting them, they soon fade. When other objects have been conveyed in the same manner, and have been fixed in the sensory, especially words, they may be recalled by the memory, and be reconsidered and compared, and either retained in the intellect thus revised, or spoken or written. In the same way the rudiments of all knowledge are introduced through the senses, and become implanted in the mind, such as various languages, and books on all subjects; everything in the arts and sciences, such as arithmetic, drawing, music, and all branches of art, from the most complex, requiring great mental endowments and others requiring less, but still considerable ingenuity, to the most simple acts of the limbs.

From the stores of knowledge every one is

allowed to make a choice for forming his profession or calling, and as a very few branches of art can be learnt and carried out successfully by the same individual, there is an infinite variety made for suiting the inclinations of the great mass of mankind.

In explaining the manner in which the mind is instructed through the brain, a few subjects will be chosen from the most complex and the most simple processes, and the degree each bears to the energies of the brain and the organs of the body will be explained, for deducing the principles on which the mind may be successfully cultivated, for insuring the continuance of its activity and integrity, and for sharing between it and the body all the powers the brain is capable of allowing; and thus conducing to the welfare of the individual.

THE

BRAIN IN RELATION TO THE MIND.

CHAPTER I.

THE GRADUAL MODE OF DEVELOPMENT OF THE FACULTIES OF THE MIND.

A SINGLE letter is taken by the optic or auditory nerve to the sensory; and, by a voluntary act of the fibres of the voluntary tract, is fixed or impressed by them; and by this act, or by its several repetitions, becomes as indelibly implanted as if it had been written on paper. It can then be continued through particular fibres of the same voluntary tract to the muscles of the tongue and lips, to be spoken—or to those of the hand, to be written. When other letters have been learnt and impressed in the same manner, they can, through the voluntary tract, be combined into a word, and become fixed in this form in a similar way. When other words have been constructed, or taken already complete through the

eye or ear, their meanings are acquired by pointing to any familiar objects they represent. When words and their meanings have been thus learnt, one can be chosen and adopted for another without pointing to any familiar object; and when such information has accumulated, one or more words can be made to represent ideas.

When ideas have been multiplied, the process of thinking can be commenced on a larger scale, by which one idea is compared with another, and the result is either stored up in the mind, or written, or spoken. Every day furnishes fresh information: this is compared with the preceding results of thinking, and the stock of knowledge becomes enlarged or corrected. A great portion of it may remain fixed in the brain, but the result or meaning is preserved in the mind. The act of thinking may therefore be considered as a comparison of the ideas, and a judgment or determination for rejecting some of them, and retaining and combining the rest.

The forms of the letters and words being fixed in the brain and mind, they can by memory be conveyed from thence to the tongue without any fresh impulse from the organs of sense, but by the same means of the voluntary tract. Afterwards ideas may also be restored and conveyed by the same process, and then all the information that has

been received to the end of life. Memory is partly the result of the natural retentive powers of the brain, and partly the result of the care and perseverance with which information has been received and implanted. However much the memory may be enlarged in man, it is fundamentally the same as it was in the child, who then remembered only letters and words.

Memory is an active condition of the mind and brain, which allows a review or return of the knowledge that has been previously received. Although it is a repetition of the same process by which knowledge was first implanted in the mind and brain, and the same symbols have been retained in order in their proper places, yet from experience the meaning or interpretation of the knowledge may be gradually modified according to the difference of the habits or the intercourse with others, or by changes in the plan of study at different periods of life. Memory is generally voluntary; but it may be involuntary, as when, from the activity of the voluntary fibres in a state of mental vacuity, images are forced into notice, as in reveries. The meaning of a composition or discourse may be accepted by the mind, and the symbols by which it became understood may be forgotten, or they may abide for some time, as the very words can be recalled and

conveyed through the organs for being spoken or written.

The memory may be increased and strengthened by exercise, and the mind may be improved by recollecting useful knowledge and occurrences, which would otherwise have faded away. As it is active it can remember all things it pleases; and by a relaxation of its powers forget worthless ideas and occurrences. By frequent repetitions of its power it can fix all things that are likely to be useful, so that they will continue for a long period. The rudiments of knowledge, as the words and rules of grammar, may be forgotten: but frequent examples in reading will restore their import.

The mind may have its own powers of remembrance, but it is by its connection with the sensory and voluntary tracts that it is enabled to restore the forms of words, symbols, and figures. If figures and forms are thus recalled and seen, as it were, by the eye, and heard by the ear, so that the realities seem to be present, it is according to the preceding process, and they are then reflected by the sensory to the sentient nerves and organs.

If all mechanical processes connected with thought seem to be purely mental, there nevertheless has been the same co-operation between the sensory and voluntary tracts as if the symbols, words, or

letters had been actually conducted to the hand or tongue, and had been written or spoken; and this is in a great measure a repetition of the previous exercises of the voluntary power by which the information was first received. The preceding observations contain the principles through which the mind becomes instructed.

In thinking, facts and truths are the only substantial subjects worthy of notice; for most other things lead only to a dissipation of the mental powers. In the acquisition of knowledge this care is especially required, as it sifts all the former attainments, and fixes those that are worth keeping and discards those that are useless, and thus makes room for further improvement. By exercising the faculties in this manner they become stronger and more capable of making such additions as tend to the real increase of knowledge without encumbering the brain and mind.

There are precise modes in which the brain favours the action of the mind. In thinking, there is a moderate activity of the cerebral structure, but a subdued or quiet condition of the external organs of sense and motion, that the entire energies may be concentrated on the subject under consideration. This exclusive state is changed if mechanical powers are used at the same time, such as writing

or speaking: there is then a somewhat divided attention, or a modified activity of each process. The most gentle use of the will changes the quiet state of the mind and imparts activity for enabling it to complete the act of thinking. The more energetic exercise of the will in the production of powerful muscular motions leaves very little liberty to the intellectual faculties. The processes of thinking and remembering are as much acts of the will as those which produce the motions of muscles.

There is a great variety of ways of storing the mind with knowledge: some of them depend on the mode of education, and some on the great natural powers of the brain and mind. Some persons, by the power of thinking and memory, can prepare and fix in the brain larger deposits of information, and bring them forth with order and precision by writing or speaking; others are obliged to write them quickly, as they would not be retained for being sufficiently matured and combined, but must be written and afterwards arranged and corrected. There is a peculiarity of expression in some, arising from the quality of the intellect, or brain, or external senses, or from education or locality. There may be a fluency or explicitness of speech, high-sounding or soft and quiet words, plainly or poetically

expressed. Explanations may be made briefly and significantly by other words and facts; but they may be also attempted by such varied modes of expression by different persons as to make the conclusions appear very different. The numerous meanings attached to words show a want of fixed principles; and as they may be interpreted in one way by one person and in another by others, great intricacy and obscurity are thus occasioned, and the understanding is often led from what ought to be real to what is bordering on the fictitious. A good picture contains such fundamental principles of expression that their meaning cannot be so misinterpreted, and therefore forms one of the most unerring modes of instruction. If words could be used with a single meaning, there might be less elegance of expression, and there would be fewer books written; but the knowledge the world would possess would be infinitely more satisfactory and more conducive to the advantage of people in general.

CHAPTER II.

LETTERS AND WORDS AS EXPRESSIONS OF THE MIND.

EVERYTHING to be admitted by the senses must have some form when it is presented to them, otherwise it would convey only a general perception, however subtle or exalted its power. The spiritual mind would have been useless in the body unless it had been capable of being approached by, or of approaching, the various parts through proper modes of communication. The mind can therefore only instruct or be instructed through the brain, which is to be in its immediate presence, or through the nerves which are to lead to or from it, or through the organs qualified for preparing material things for its reception and notice, or for carrying out its commands. It is in this manner only that the intellect can be informed and made capable of controlling the muscles and limbs. The brain, and nerves, and organs, are adapted with precision for the faculties of the mind and body, and although the mind can only receive mental qualities, it must

be approached by such means as convey their resemblances, however remote they may seem to be from it, and thus words come to have a mental as well as an organic or symbolic meaning. There cannot be a perceptive quality in the air itself, but in the import of the words which, from use, have been brought to represent the mental perceptions and emotions, and of the music which agrees with the representatives of mental emotions. A figure having a strict likeness of any object will convey its meaning as well as words. It is not, therefore, any quality of air or light, but the mental quality, which is unlike the perception derived from, or belonging to the material objects themselves.

The retina is not qualified for receiving anything more penetrating or brilliant than the light, and it requires the light to be subdued for ordinary purposes, not only in man, but in animals, for, when the eye is made for receiving a higher degree than ordinary, there is some compensating structure or habit. It must be concluded, therefore, that the intellectual essence has higher qualities and a different nature from light, and does not approach this in its full brilliancy. When light is required for conveying information to the brain, it must be through an outline, which represents symbols or letters, otherwise there would be only a bright

cloud. The air has a strong outline made through its pulses in conjunction with the mechanism of the ear, otherwise the pulses of the air alone would be heard either unharmoniously or unmeaningly. For determining other qualities of matter, special organs have been constructed. No idea of a spiritual nature can be conveyed to the memory except it be bounded by an outline, and this can be only a nominal representative of it; anything spiritual to be seen must be either brighter or darker than light, that the light may be an outline to the spirit, or that a darker colour of the spirit may be an outline to the light. It is only by similar comparisons that the mind can form an idea of spiritual elements, and therefore it must receive light bounded by lines, for words, or other symbols.

There is no certain way of conveying the result of one man's mind to another by mere presence, or by the features, or other outside appearances; special modes, therefore, have been devised for the purpose. The intellect has been placed in the brain arranged for admitting information by one set of organs, and of fixing or impressing it by another. As all the organs of the senses are material, they can only convey material images, and not mental or spiritual ones; these must, therefore, be represented by forms calculated for being accepted and

understood as such by each organ of sense. The symbols for this purpose remain fixed in the brain for a longer or shorter period, the meaning in the mind, and the mind can, from time to time, resuscitate the meaning alone, or the symbols themselves, in harmony with the meaning through the same parts that implanted them, and thus re-impress the brain either through its own act alone, or by causing the tongue to speak it, and thus returning it also by the ears. By repetitions in these several ways the memory of the mind becomes quicker and more enduring, and the symbols fixed and permanent as in the handwriting or in oral pronunciations, or any other representations of the arts and sciences. It has thus the power of comprehending and considering, of retaining the meaning of impulses only, or the images of such as it has selected and imprinted through the repeated acts of the voluntary tract; so that there is a memory both of mental acquirements, and of such as are made between the mind and the brain. In this way the sense of any duty remains in the mind, whilst the precise words, which first represented it, may be either fixed or faded, or supplied by others, as in examples learnt from esteemed writings.

Some of the properties of the mind are entirely spiritual; others are more dependent on its connec-

tion with the brain. Through its own powers it preserves the result of its labours in all those sentiments it esteems of value, and also all those it dislikes as being inimical to its welfare. Through the mechanical properties connected with the brain it contains the images or representatives of all the symbols, by which it became instructed, and by which its future instruction is to be continued. These constitute the forms of the letters and words in the several languages; in figures for calculating, and forms of all other objects that have been remembered. When the large sum of these is considered, and that they are in a great measure absent in animals, it is not surprising that the human brain should be so extensive in proportion to the size of the tracts of the physical faculties.

All knowledge must be represented by symbols, and by them impressed on the brain, whilst their meaning is conveyed through the brain to the mind, and when this meaning is to be given by one word to another, it must be by an equivalent to that it is to represent. It is not necessary for the form of representation to be of the same exact shape for this purpose, but it may vary according to the determination of a country or people. By the same rule, the information which is conveyed outwardly from the mind by speaking may be varied by giving to

the voluntary organs a peculiar mode of action and expression. In this manner, letters, or symbols, or words may have any desired form, so long as they represent the meaning to be conveyed by the organs of sense to the mind; and their return from the mind may be further modified by words of another language for expressing the same facts. This proves that the mind itself receives the meaning or import of the images, and can then return them outwardly by the voluntary organs in any corresponding form it has been made acquainted with by previous learning. Thus Roman, Italian, Greek, or German, or any other form may be received by the mind as the representation of any letter, word, or idea; and it may be returned outwardly by the same or any other of the preceding forms of speaking or writing; and in like manner the pronunciation may be varied, as when a man hears a language from a person of a particular country, and returns its meaning in another quite different, like an interpreter. He may learn the letters and words of other countries without knowing either their use or meaning; but as soon as he comprehends both these qualities, he can substitute the letters and words of other countries for those of his own. However many the languages he learns, the symbols of all of them must be imprinted on his brain. Although he

comprehends the meaning of everything he reads or hears in various languages, in ordinary thinking his mind is exercised almost solely through his own, unless he has been removed to another country, the language of which has become more familiar to him than his native one.

When a person changes writing for type, in carrying the words through the brain to his fingers, or substitutes his own handwriting for the same purpose, the letters may be in any form, but the process is entirely mechanical. The translator, however, on seeing or hearing a word, and by understanding its meaning, can pass it through his brain in the form of any other country as its representative, and write it, or read it, or put it into type; and if he understands languages thoroughly, and the subject especially in which he is engaged, he will give it a mental translation, and not a mere verbal one, and will suit his expressions to the idiom of the country the language is to represent. For being able to do this he must have the rudiments of each language fixed in his brain, especially the letters, words, and meanings, the facts and occurrences, but he may vary them and place them according to his own will and pleasure, for producing a harmonious perception in his own mind and the minds of those who are either to hear or read his composition.

Translations have many disadvantages, especially when they have passed through several languages. From the difference of the construction of the adopted language, the facts may become so combined as to be in a very considerable degree at variance with the mind of the author; even in a literal translation some modifications must be made, and by further changes in other languages the original may become very much misrepresented; persons, therefore, reading it in the language of the author himself thus enjoy a great advantage.

If the form of the letters be very different, much of the same process is required for learning another language, and as so much labour must be employed it is not to be expected that a great many can be properly mastered by the same person, unless their words and modes of combination resemble each other in a considerable degree. According to the same rule many branches of art cannot be successfully entered upon; and generally, if there be much complexity in it, one is as much as can be perfected, for the limbs must become gradually fashioned to its execution, and the mind must be intent on its direction. If attempts are made to learn several, the one first adopted for daily occupation will have so riveted particular fibres of the brain and corresponding actions of the muscles to its performance,

that it will always continue in the ascendancy, and leave the others imperfect.

A good picture answers the purpose of every form of letters and words, and constitutes more than any other means a universal language, for it is understood by every one of whatever country he may be a native; the names of the various characters introduced into it may not have been known, but the whole conveys the full expression of a mental history. The emblems, therefore, representing words and ideas in some countries have a stronger and bolder meaning than many have considered to belong to them, and are capable of conveying more intelligence accurately to all nations of the world than any other single plan or device, provided they are sufficiently well executed for showing their meanings. Still whatever may have been the original forms of letters in use, it is clear that varieties of shape have been adopted by different people according to their own inventions. So long, however, as the letters and words in use answer their intended purposes, they leave very little chance of effecting any change, however feasible another plan may appear. The greater the simplicity and uniformity of letters, figures, symbols, or objects that can be devised for conveying the same meaning, the more advantageous would be the change to every country.

CHAPTER III.

SPEECH, WRITING, AND CALCULATION AS EXPRESSIONS OF THE MIND.

The first instruction enters by the ears, and is spoken by the tongue and lips. When words are spoken, both sides of the tongue and the vocal organs, and both sides of the brain, are engaged in conveying the same thoughts, and modified actions of the respiratory organs are required, so that there may be a due co-operation with the other parts employed. The nerves of sensation, volition, and the involuntary power are concerned in the utterance of cries and other natural expressions of the passions, and they can be increased or subdued by the will, and a much more varied co-operation between the same faculties is not required for their production than for corresponding degrees of ordinary respiration. Very complex combinations are, however, necessary for perfecting human speech: a peculiar action of the lips and chest, in concert with the lungs and glottis, must be produced through the involuntary nerves, and the words must be rendered accurate

and distinct through the adapting properties of the sensitive and voluntary nerves. The power of utterance is inherent through the mechanical arrangements of the throat and mouth, but the peculiarities of speech must be acquired through the sense of hearing, and modified by the power of the sensitive over the involuntary and voluntary nerves, and completed through the intellect. A particular language is modelled by the organs supplied by these several nerves in co-operation with the brain and the organ of hearing; it varies in precision according to the pronunciation of instructors, and the perfection of the organs, and the imitative attention of the learner. Through these means a peculiarity of speech is confined to each separate country, and is further modified by the dialect of any particular district.

As all knowledge that is received by any person must enter by the senses and be imprinted by the mind, the truths, or foundations on which it is raised must have had a previous existence in words and things. Words could not have entered the mind of any one without an effort of the will, through the voluntary tract, and they could not have been accepted unless they had been offered, and, therefore, the knowledge of language was at at first a divine gift, and not an acquisition

derived from the inventions of man himself. It may be objected that if the active agents of the organs of speech existed in the brain, and the organs themselves were perfect and peculiarly constructed for speaking, no difficulty could have existed respecting mere utterance. In the deaf and dumb all these parts may be perfect, and the want of speech depend on the deficiency of hearing, so that, if a voice had never been heard, language might never have been formed for conveying instruction with so much clearness and facility.

If written exercises were also spoken, they would have another chance of becoming firmly imprinted on the mind. Speech is one of the most important processes of the human brain and mind in connection with the lips and tongue, and the respiratory and vocal organs, and as it depends for its perfection so much on the ear, every person should become acquainted with the tone and condition of his own mode of speaking by frequent repetitions, that he may correct its deficiencies, and make its powers perfect. If those learning music were only to write or learn their notes by heart, and use their fingers on the keys of an instrument in dumb motions, the real object would be superseded; and in the same manner the perfection of speech, which also depends on accurate

sounds, cannot be attained without similar clear expressions. For want of this previous exercise, persons who have stored their minds with every kind of knowledge, feel unable to give utterance to any portion of it with a proper degree of advantage.

As all knowledge is fading, and it was found necessary to preserve it for the information of others, and for future consideration, as well as for preventing a repetition of the labour of acquiring it, and for various other purposes necessary in society, writing has been invented. It may be an exact imitation of the shape of the letters, learnt or spoken, or only a preservation of some parts of their form; as there are peculiarities in this respect in many countries, and indeed a certain degree of them in every individual even of the same country.

The handwriting is directed by the will, like all other mechanical operations. It is begun in childhood and youth, and is an imitation of copies set by a master, so that there may be a resemblance of the same writing throughout a school or community. Some of the difference in writing is owing to the hand and the power of the muscles, and some to attention or carelessness; but the form it has then acquired will continue with little difference throughout life, so that it may, at any time of

repetition, be plainly discovered to be the same. It has been frequently looked upon as denoting the character of the mind; it may be so in some degree, but not by any means so frequently as to lead to any correct judgment. It is the completion of mental operations by one means, and the fibres of the brain which are concerned in the mental acts, are continued into those fibres, which lead to the hand for its accomplishment; it is therefore one of the assistants of the mind, but is related to it more by the import of the words it delineates, than by the form of the letters.

When the hands are used in any nice or light operation, modifications not only of the sensitive and voluntary organs become necessary, but those of the involuntary, for a gentle respiration is then required, and through the combined influence of the involuntary nerves with those of the sensitive and voluntary, and the consent of their appropriate convolutions in the sensory, the will is enabled to control the voluntary muscles usually excited through the involuntary tract. In writing, the respiratory organs and chest must moderate their activity for giving a steadiness to the right hand, and although this alone be ostensibly used, the left is usually kept still by the continuation of the same muscular activity, so that there is a reciprocity of co-operation

with both sides of the brain, as there would be of the tongue and lips in speaking.

Writing being a mechanical exercise, and not much engaging the mind, may appear to be capable of being performed without injury or fatigue. It is so as far as the motions of the hand are employed; but as this cannot be kept steady unless the motions of the chest are restrained, too long a continuance of it at a time cannot be made without diminishing the due changes of the blood by respiration.

Figures and numbers require to be learnt in the same way as letters and words, and there must be the same process of fixing these rudiments as was used for writing letters and speaking them. When the principles have been learnt and fixed in the mind by frequent repetitions, calculations may be readily undertaken. This process is generally carried on by marking them on paper, as requiring a less effort of the memory; but it may be conducted entirely by the mind, and the results be then communicated either by speaking or writing. There have been persons, who have been able to execute the mental arithmetic in a most surprising manner, and it seems to be more of an act of the memory than of the ordinary thinking powers, as the figures are few and well defined, and have only to be

remembered and combined for allowing the completion of a calculation. The rudiments having been properly fixed, all the mental deductions can be completed by exercise, and these processes are conducted in the same way as those of other branches of learning. They are frequently considered as being subordinate to other parts of education, and do not receive the attention necessary for insuring their perfect knowledge. They are, however, of inestimable use, and their rudiments ought to be fully comprehended and implanted in the mind. They tend to make the uses of the mental faculties accurate and correct, and show plainly all errors arising from too hasty conclusions. The certainty of the knowledge they impart seems to possess a great advantage over that arising from the more partial insight any other branches of art or science have into the operations of nature. Their use in astronomy may be considered marvellous, and although this forms one of the grandest discoveries made by the human mind, and the accuracy of the calculations are so complete, and it shows the order of creation in a manner so satisfactory, it leaves a desire for comprehending the intimate economy of the planets; but this knowledge is so unapproachable, that any glimpse of it is almost an impossibility; and, therefore, the study leaves a vacuity which is more easily

and agreeably filled in ordinary persons by less exact but more speculative studies.

The notes of music are learnt and fixed in the mind in the same way as letters and words, and these may be written or spoken, or extended to the fingers to be repeated on a piano or a violin, or to the lips to be repeated on a flute, or other wind instrument. Complex compositions are then learnt and repeated on the same instruments. Afterwards they may be accompanied by singing, the forms of words corresponding with the music, and conveying various mental qualities, the musical notes harmonising with, and heightening the various mental emotions excited by the words. The whole may be fixed in the brain, and remembered and called forth whenever their repetition is desired. Every step in music is the same as in learning letters and words; and when the rudiments have been thoroughly implanted, the same processes may be begun which are employed for thinking, and there is the same power of increasing the knowledge through the mind itself by comparison and the interchange of ideas, and the production of new pieces. When music is properly learnt and sedulously pursued and cultivated, it is capable of heightening the intellectual powers, like other learning, but it then forms a separate branch of knowledge, and requires all the time and talents

of the individual for its perfection. By persons therefore having other occupations, only some degree of it can be obtained, but this may be sufficient for forming an agreeable pursuit and recreation. When it is accompanied by singing, the words having high mental qualities, and the music corresponding with them is pleasing and well expressed, the whole is executed by one of the most complex assemblages of the faculties and motions the mind and body are capable of effecting conjointly.

CHAPTER IV.

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VARIOUS ARTS AS EXPRESSIONS OF THE MIND.

When a person paints a stroke or surface, copies a word or symbol, or a flourishing ornament, however highly they may be gilded or coloured the several acts are only mechanical processes, conducted by the organs of sense and voluntary muscles. If the outline of a picture is taken through tracing paper, the hand follows the eye from one moment to another, and each stroke of the pencil is forgotten, and not impressed on the brain and mind. When, however, he paints a sentence which conveys one or more ideas, or a tree, or an animal of a particular species, he thus also conveys correct ideas. If he paints words giving several ideas, as benevolence, fortitude, or other qualities, and paints the faces of men with the expression of similar ideas, he pourtrays the same mental properties in two different ways. If he writes a history, and paints the same characters in a large picture, so as to convey their prevailing

passions in their features, their appropriate costumes, and their equal or subordinate places, and in the background some peculiarities of the country in which the scene occurred, there is the same mind devoted by the artist in two different modes of expression; but in the painting the hand has been made to execute higher intellectual qualities than can be shown by writing, or in any other manner.

It has been previously explained that words have a mental as well as a material meaning, but words consist only of strokes, and if written in another language, which is not understood, convey no idea of any kind; and it is the same with a book or history in an unknown tongue. A good painting is not subject to this contingency, for it not only gives the whole history, but shows correctly the principal objects, and the mental meaning of all the parts pourtrayed in it. It shows, also, the mind of the artist by which it was completed through the hand. The eye and will might have directed the muscles to give form and colouring, but the mind of the artist must in the good picture have been co-operating with the will to have produced the mental meanings of the various characters introduced into it.

If an engraver writes on a copper or steel plate ever so beautifully, he performs a mere mechanical art; if he copies an elaborate drawing, that gives

some similarity of the objects contained in it, he does very little more than in the writing, for he has reduced the size of the original by rules and lines, and followed the previously-traced marks on the copper plate; but if he gives the true character to the objects, such as the expression of the countenances, the correct attitudes, and other properties, he shows his mental capacities and the mental qualities of the drawing at the same time; but his accompaniments are not equal to those of the original designer.

There may be some difficulty in comprehending how the image of any thing is transferred to the brain, and from thence to paper or canvas, or to be moulded or engraved; but a little consideration will render the whole process capable of explanation. The image enters the eye in a very diminutive form, but does not abide there, or in the optic nerve or the sensitive tract. When the image is about to be permanently or completely fixed in the brain and mind of the artist, the features are examined with great care, and then, or after other interviews, the image is transferred by the optic nerve to the sensory, where, through the vital agency of the voluntary tract, it becomes fixed on the mind, and thus formed is continued to the muscles of the hand and the pencil. The image thus formed in

the brain is very diminutive; but through the connection of the voluntary nerves with those that impressed it on the mind, it can be made to extend to its just proportions by a larger or smaller sweep of the arm and hand, according to the required magnitude of the picture.

In making the cells by the bee and wasp, there is nearly the same process as in drawing and modelling, the hexagonal facets of the compound eyes carrying the precise shape of the impulse to the voluntary tract in the brain, for directing the required action in constructing the hexagonal form of cells. The bee and wasp have been considered as possessing correct mathematical ideas in making their cells hexagonal; but their compound eyes are divided by hexagonal marks; and as the motions of the muscles of animals are directed very much by the mode of admission of light, the shape of the cells may be in accordance with that of the surface of the eyes. In all imitations of objects the muscles take a form of action from an organ of sense—the pattern is received by the eye, and thence conveyed to the brain, and having produced in this a precise impression of its form, the action of the muscles is modelled so as to continue its representation. The images of external objects always falling on the brain of the bee or wasp through the hexagonal

divisions of the surface of the eye in viewing near objects, produce such habitual motions of the muscles as constitute unconsciously the hexagonal form of cells; and thus one of the faculties of instinct is accounted for, and the cause of the mathematical exactness explained.

If a net, whose meshes are of a particular form, obstruct the view of a part of the image to be delineated in a picture, it would appear numerously intersected by it. If the threads of the meshes be so fine and the distance to the image sufficiently great, the threads are not seen, but only a dullness of colouring. If, however, the image is near enough, the threads must appear; and, if thick enough, divide it into numerous pieces. When a bee or other insect is flying, the divisions forming the hexagonal facets of the compound eyes may not therefore obstruct the general view of large objects; but whether they are thus seen, as perfect objects are through the plain cornea, is another question. When they come to work by the hexagonal eyes, which they must do very near to the cells, the light must pass through the eyes so as to give the precise hexagonal form to the objects on which they are working, and in this shape convey it to the brain and thence to the muscles employed in the operation. Sometimes the cells of the honeycomb are

not of the precise hexagonal shape: this deviation may arise from the obstruction caused by the numerous hairs placed about the eyes, or from some failure in the form of the facets, as it is not unusual to find, after making preparations of the eyes of insects, that some of the facets form squares and not hexagons.

If men are employed in the construction of different portions of a complicated machine or engine, each does his part according to a rule or pattern; but when one comes to put the whole together, and make the engine perfect, he shows clearly the employment of considerable powers of the mental faculties; but not in so great a degree as the designer, who had previously to calculate the required strength of every part, the capacity for motion, and the combined powers of the whole. In several works both the arms and legs are used at the same time, but still the whole process is a mechanical one and imitative, like that of the bee, the performance varying in nicety of execution according to the perfection of the instruments, and the experience and dexterity of the operator, but showing very little participation of the mind.

The quickness with which mechanical operations are conducted may be observed in the act of sewing. In every stitch the eye of the worker sees the point

of the needle in contact with the piece of work, and the impulse directs the hand to push it partly through the cloth; the eye then, by another impulse, directs the fingers to take hold of the point of the needle and draw it and the thread through the cloth, and this act is also accompanied by the feeling of the fingers. The operation is nearly the same in knitting or netting. When the act of sewing is witnessed by one stitch following another with such facility, it may seem that so much complexity as has been described cannot be required. In the same way other mechanical arts are completed by sawing, filing, hammering, and other manipulations —slower movements becoming necessary according to the size and weight of the instruments employed. In the spider the act of weaving is more simple than that of sewing, but the principle on which it is done is the same: the impulse from the threads must pass through the eye, and then be continued by the voluntary tract in the brain to the muscles of the limbs employed as instruments. Words are carried through the brain in nearly the same manner as the impulses from the needle in the act of sewing. The words may be fixed in the brain, and so may the image of the needle in the precise fibres implicated in actuating the muscles which cause the fingers to conduct it through the cloth.

If an outline is to be made of a person in any act of occupation, as in the act of sewing, or of a spider with its thread ready for weaving, the image of the whole of each process must pass through the artist's brain before it reaches the hand for delineating it, nearly in the same way as the image of the needle passes through the brain of the worker, or that of the threads through the brain of the spider.

If a piece of metal is to be fashioned to a particular shape, impulses for producing motions for the strokes of the hammer pass through the brain either by gentle or forcible corresponding impulses to the hand, according to the required thickness and form of each part. If the extension of pliable matter is to be effected by both hands there is a modification of the same process. When a very large and heavy hammer is to be wielded, the impulses required for giving the proper force pass through the brain in the same way as that of the needle, but a much greater extent of the voluntary tract is employed. A great preparation is also required for allowing the process to be conducted without injuring the body, and for giving due effect to the strokes. The organs of the senses are not much engaged in the process, but the brain must bring all its physical power into requisition. The whole body must have a firm position, except the arms. The chest must

be expanded to the utmost at the time the hammer is uplifted, and not contracted again until the force of the stroke is completed, and thus for repeated strokes every energy the brain is possessed of is required, except the small amount of the intellectual required for superintendence.

When animals perform their muscular exercises the means are the same as those just described, only with variations according to the kind and degree. Animals seldom use their arms for so many purposes as man does, but the motions of all their limbs together may be much more forcibly exerted. When the racehorse is running at full speed, nearly the whole of the brain occupied by the voluntary tract is in its utmost degree of activity, as well as all the muscles of the body. It may be the same in other acts, when the muscular system is very much engaged.

The foregoing observations have related to the minds of individuals, but there are others who act in concert, and expedite a piece of work by alternate actions. But as so much is now done by machinery, no further notice will be taken of them except in companies. In a room during the revolutions or other motions of machinery numerous persons are engaged at the same moment in similar actions, thus showing the same activity of their mind and brain, their senses

and limbs: and although they are so attentive to the motions of the various parts, and appear to be entirely guided by the machinery, they are kept in a more strict obedience by the presence of a supervisor. In many other branches of business one room full of persons is occupied in one kind of manipulation, and another in another kind, and all these are subjected to the control of a superintending mind. In building a ship, or cutting a canal, or in cutting and levelling a railroad, hundreds of people are concerned at the same moment in similar kinds of work, and are to bring the whole to perfection, and in each of them there is an engineer or overlooker who controls the entire business, and to whom the numerous persons are subjected. It may not seem at first sight that their wills and minds are brought into obedience to that of the engineer, but for their wages and sustenance; but they act also in this way in order, under the guidance and discipline of the laws, and therefore under the mind of the legislature.

In the preceding pages some branches of knowledge have been adverted to, and if others had been considered they would only have required a description of different instruments and a varied degree of dexterity for their proper use, whilst the actions of the brain and mind in directing the operations would very much have resembled each other. In all such

processes, however, there will be different degrees of mental energy required, inasmuch as the machinery employed may have more or less intricacy and demand a more considerable attention, and the materials subjected to its control and power have their inherent proportions, for which calculations are to be reckoned and allowances made. In some arts only a small degree of mental energy is manifested, and other performances are still more simple, and show little more than a mechanical dexterity. The consideration of the various kinds discovers different degrees of activity of the brain and mind, and consequently the accompaniment of more or less fatigue and exhaustion. What in the highest demanded so much attention could not be continued without intermissions, whilst the more simple requires a less intent application, and the energies are therefore slowly expended, so that a more steady continuance of labour can be permitted throughout each day. The highest exercises occupy the entire attention, and leave no room for interruption; but the lighter processes allow some of the faculties of the mind to be at liberty, and fit for conversation. It may therefore be readily understood how the higher intellectual pursuits by continued attention weary the brain, whilst the more simple processes, by allowing some kind of relaxation, do not cause

the same waste of energy, but allow the labour to be continued for a much longer period. Learning and the higher branches of art are apt to be considered with some degree of jealousy, but the exertion by which their acquirement is made is far more unpleasing than that necessary for gaining mere mechanical dexterity, and is attended with ailments, which the more active occupations are strangers to.

CHAPTER V.

DIFFERENT CONDITIONS OF THE BRAIN FOR CO-OPERATING WITH THE MIND.

When the image of anything or a letter is first transferred from the eye to the brain, some experience is required before it can be spoken, written, or drawn, so that it is only by repeated trials that any rudimental forms can be steadily transferred through the organs of the senses and brain, and executed by the muscles in a proper form. The words are at first imperfectly pronounced, the strokes of the letters are tremulous and uneven; then the words are pronounced thick and loud, and the letters are formed large; so that it is some time before either the brain can convey distinct impulses, or the muscles execute precise motions. When another language is to be read or written, it is again some time before the proper form is acquired by the hand and the pronunciation by the tongue and lips. It therefore seems, that every act of the voluntary tract and muscles must be gradually learnt, at least in all the rudimental acquirements of knowledge.

The rudiments are designed for youthful occupation, for they are then not only the most easily performed, but from the persuasive and pliant condition of the brain and muscles, are the most likely to be permanently planted and fixed. By early beginnings the brain and muscles become so fashioned, that, for the rest of life, the same forms are continued, as may be observed in the handwriting and any of the arts which have been adopted, so that particular individuals become noted in every science and occupation; and if to this experience a correct knowledge of the principles of each science has been added, the person becomes fitted for occupying the most eminent position in his particular profession or calling.

Every mechanical act done by the hand or other organ has its outline formed in the voluntary fibres of the brain. Some animals, as soon as they are born, get up and use their limbs correctly for walking, running, and also various other parts or organs for other purposes: the brain is then sufficiently mature in certain parts, and the limbs are firm and strong for giving the necessary support. In three weeks from the commencement of incubation the chick is perfected, so that it can use its eyes perfectly, peck and run: a child is generally more than a year before it can perform similar

actions with the same degree of perfection and steadiness. It may therefore seem that the want of steady motions in writing depends upon the immaturity of the brain, but this opinion cannot be maintained, for when grown-up persons want to learn to write, they can hardly make a mark with a pen, and a person unaccustomed to drawing handles a pencil with great awkwardness, and cannot form the resemblance of any object, although he may be a good writer; and the same may be affirmed of every other branch of art that has not been previously learnt. There must be a change effected in the brain of the child for producing the required steady motions, and for want of this in the special fibres that join and co-operate with those exciting the ordinary motions of the hand the man cannot write or perform any other fresh act with expertness. The difference between the slow maturity of the brain of the child, and the quicker maturity of that of the animal, may exist on account of the slow development of the mental faculties, and the necessity not only for the proportionate development of the power of the muscles, but on account of the peculiarity of these motions which are to be exerted so much in co-operation with the mind.

It seems that all the fibres of the human brain must undergo some change for bringing them to a

proper condition for activity and steadiness, and this is the reason why all manual arts should be begun early, and even intellectual pursuits, as they are with so much difficulty allowed to come to perfection in mature age. Every fresh impulse requires one or more fresh fibres of the voluntary tract for its perfect reception, and thus so large a brain is necessary for the almost unbounded extent of the powers of the intellect of man; therefore, however hard he may work, and however much knowledge he may acquire, there is always room left for further stocks of information. He can occupy as much of his brain, however, as he pleases, and according to the degree of his industry, or idleness, will be his intellectual progress, so that the extent of his attainments rests with himself. By the necessity for such use and proceedings he becomes possessed of a deliberative power of acting, and of using his muscles, and thus gains the form and character of his hand-writing, which he retains to the end of life, whether it be good or bad; the one has been perfected by care and attention, the other by slothfulness or negligence, unless bad instruction or some disorder has prevented the proper development of his powers. In the same way artists form and retain good or bad methods of drawing, and in which artificers excel or not, in their several branches.

The large extent of the brain forming the convolutions and voluntary tract is nearly the same throughout, and when it has been stored with letters, words, and ideas, in various languages for some years, the vast number of fibres composing it may have been over and over again impressed, and a large portion may be still occupied permanently, as there have been persons, whose memories have been so great, as to have retained almost everything that had been learnt. In others, the brain may have been very much occupied, and only a small portion of information have been retained by it, but in many it has been very little impressed except by such spontaneous occurrences as have been every day presented to it, and the mechanical objects which form the principal occupation of each individual. Whether it has been largely or sparingly stored, it has been by varied degrees of the same process, and whether the impressions have faded, or been continued, the faculties of the mind itself may have been similarly employed, so that whilst one retains all the details by which the mind has been instructed, another preserves only the mental qualities. It is a great advantage to have a brain so retentive, and a mind so in harmony, but it is more desirable to have had the mind itself replenished, and the words forgotten, than to have a capability of pouring forth

words, in whatever form, in the meaning of which the mental faculties have had a very slight participation.

When information has been communicated, the words are either retained in the mind or written, or by repetition they may be so impressed as to be continued permanently; but after they have been written the mind may be made nearly as free as if they had been erased. This, however, cannot always be done, and especially in very strong memories, or if the words have affected deeply the passions. It may be presumed that these parts are prepared for receiving the communications and the repetitions of erasures and receptions; for it cannot be conceived that those already occupied have other impressions and communications of words made in them, but that fresh parts of the brain are employed; and it is only in this way that some prodigious memories can be accounted for. With respect to the attainments of different persons, there is the utmost variety: ignorance is usually attributed to weakness of memory; it is, however, probable that if proper pains had been taken to impress information on the mind and brain in early youth, there would not have been those occasions for showing such weakness. It would not then be decided that the original powers are much

greater in one than in another, as to the quantity of learning capable of being introduced and retained by every person of ordinary powers, if proper methods are used.

The power of making acquirements varies very much in different persons, a circumstance ascribed to the larger or smaller proportions of particular parts of the brain. When the brain is very much contracted, such a reason may be valid, but it is oftener to be attributed to a defect in education. A large brain is generally considered to be favourable to the extension of the intellectual faculties, but a small brain has also been found capable of promoting high attainments. The difference may depend on the quality of the fibres; but the small brain, without any difference of composition, may, through assiduous study, have been sufficient for allowing a great extent of knowledge, and as much as is usually reached by a larger brain, which is seldom exercised to its utmost limits. It is difficult to determine how small a brain is capable of as much intellectual power as will not be considered low enough for constituting an imbecile person or an idiot, until attempts at instruction have been prosecuted extensively enough for determining its capability of ministering to intellectual functions.

If the organs of the senses are perfect, and the fibres connected with the voluntary tract in smaller quantity than usual, and their powers slow, they may only require to be more sedulously exerted than in persons having a more complete brain. If there is a dullness of the organs of the senses, there is probably a want of intellectual power throughout the brain; otherwise, attempts ought to be made at instruction, and words may in time be learnt and fixed, as well as their meanings—also figures, writing, drawing, music, and other branches of instruction.

Although the brain affords the means of very extensive mental acquirements, it does not appear to be required that every person should keep the whole of it in exercise. It is thus constituted that there may be varieties of pursuits and attainments suitable to each kind of occupation; and according to this regulation every person has the power of competing for, and attaining, the highest position; and the community is supplied with learned men, statesmen, commanders, professional men of various grades, the most expert artificers, and the most intelligent persons for superintending the concerns of every other occupation or calling.

In early youth the brain is not only the most susceptible of impression, but the most capable of

retaining it. As life advances the brain varies in respect of its powers, and loses much of its susceptibility of imprinting letters and words so that their memory may be permanent. It is then maturity of thought and judgment exercise the greatest power and allow the mind to receive the highest qualities of information. If the two seasons are reversed, the advantages of either are gained with great difficulty and uncertainty. It is most probable that unless a person is gradually educated from his youth he will not attain to excellence either in learning or the arts; and there are great difficulties in changing his position and leaving off an accustomed business, which depended on manual dexterity.

CHAPTER VI.

THE BRAIN IN RELATION TO BOTH MIND AND BODY.

THE brain is required for educating the powers of the body as well as the faculties of the mind in everything that relates to the material world, and both together demand its special influence. It may be devoted almost entirely to the uses of the body and very little to those of the mind, or, on the contrary, the mind may engross its entire powers, so as to leave those of the body in a considerable degree inactive and inefficient. All the muscular powers are under the influence of the will, and this may direct them so as to spend all the energy, but when the mind is directing the will, it restrains this great activity, and the more its powers are in the ascendancy, the more the muscular motions are subdued, so that they may be only partially exercised, as when the arms are employed in some intricate mechanical operations that require much attention, also in writing, during the process of thinking.

As the brain ministers to the body as well as the

mind, if it is to be kept in a healthy condition, it must be regarded in both these relations. It appears to be capable of being employed nearly altogether, either in intellectual acquirements or in promoting the activity of voluntary muscles. It may then be inquired whether the activity of the same parts, which minister to the mental faculties, minister also to those of the muscles. It is not presumed that the same fibres are so engaged, unless there are mental qualities to be conjoined with the muscular. For each art there are special fibres whose powers are to be educed by repeated exercise, and for co-operation they are conjoined near the striated body with those which excite the ordinary motions of the hand or other part. Besides, the physical power generated in the brain, which would have kept the voluntary fibres in connection with the mental faculties in activity, is employed in the excitement of muscular motion, and therefore they are weak for want of it, and it is the same want that does not allow muscular exertion during great activity of the mental faculties. Some degree of this power may be replenished by nourishment, from time to time, during the day, so as to keep up the efficiency of the brain, but at length this capability in a great degree ceases, and there must be repose and sleep,

and then this preparatory power again accumulates, and the weary fibres of the brain, as well as the voluntary muscles of the whole body, have had time to rest. Therefore, as there is only a certain quantity of physical power for sustaining the exertions of the brain, it may be divided for allowing the brain to minister moderately both to the mind and to the will and muscles, or it may be wholly expended on either.

When the brain has been occupied either in intellectual or mechanical purposes, the parts for promoting each of these become habituated or prepared for continued exercise, and it may be a question whether the powers of the parts not so employed deteriorate. Up to the age of manhood, or a little later, either condition may be in some degree changed; but, after that period, any alteration becomes very difficult, for, although there are instances of mechanics becoming learned men, the change has been gradual and commenced in the leisure hours, and even during the time of mechanical employment; and other persons have acquired learning at various periods; still the probability is against it, and in favour of the presumption that the brain becomes less and less adapted for the uses it might have served in youth, also that it does not, at the same unseasonable periods, readily allow the

adoption of mechanical processes; nevertheless, these may be begun with some probability of success, if processes approaching them have been engaged in previously. It seems that after the full growth of the body, there is a stationary period for some things, and a gradual tendency to waste or decay. It is not presumed that there is not in every one the ordinary powers of reading or performing other intellectual exercises, for the amusement or convenience of the passing moment, or for using all the faculties to a certain extent; but it is intended to point out that for the acquirement of any extended fundamental learning, as that of languages, or dexterity in the arts, the seasons of youth and early manhood are the proper ones set apart by nature, and although they are sometimes continued to other seasons, they are not very frequently; the habits both of learning and dexterity may be extended and matured, but not begun with much prospect of arriving at any perfect success.

Many of the more common exercises of the body are required to be learnt early and carefully, otherwise the motions become constrained by the continuance of improper postures, which not only detract from the appearance, but diminish the required free actions and independence of the viscera. Varied athletic exercises tend to produce

the development of all the powers of the body and limbs, and make a preparation for any profession or situation which requires quickness and dexterity. Not only the trunk and limbs thus become tutored, but the brain and mind, and the organs of the senses learn to adapt themselves to changes of position and altitude, and remove the cause of fear and giddiness, and accommodate the eyes to varied and quick changes and motions. By such means presence of mind is acquired, which makes good sailors and good riders, and fits persons engaged in mechanical industry to work at a height that could not be borne by ordinary experience. Such employments or preparations for them may be conveniently practised by those engaged in learning, and particularly by those who will not give their minds to languages and other studies, and thus their idle and coming natural propensities may be checked with the probability of making them useful in another direction than that of acquiring ordinary learning.

By continued exercise of the mind the attainments become increased beyond all calculation, but the physical powers become deteriorated, and there is a want of dexterity often evinced in the bad handwriting, and an awkwardness in the ordinary exercises of the body. By a less mental exertion in

some professions there may be great intelligence, with all the information required for pursuing its various branches, and proportional bodily power for conducting it vigorously and successfully. By a still more partial cultivation of the mind there may exist fewer attainments, but a greatly increased dexterity, and when there are still lower conditions of the mind there may be the power of wielding heavy instruments and weapons with the utmost force. When the brain is employed by the intellect alone, it is quite unfitted for promoting the actions of any muscles, but those having the gentlest movements. When great muscular power is required, the intellect is unfitted for more exercise than guides the operations in progress, and attending to the accompanying employment of the co-operating special senses, and the concomitant variations required in the involuntary organs. The brain can accommodate itself to one or other of these conditions entirely, but if intellectual and muscular powers are to be in activity at the same time the exertions of both must be very moderate. The intellect therefore, to be cultivated to a great extent, must have the entire ascendancy over the powers of the brain, and these must be subdued, if the muscles are to be constantly exercised to their utmost capabilities of strength. Consequently, with high mental

acquirements, the organs of the body are apt to become feeble from want of due exercise, and in the other with large limbs and a great development of the muscular system, the mental faculties are liable to remain slender and uncultivated. The happiness of man seems to lie between these extremes; when a light mechanical business may be successfully cultivated, and allow the mind to be at the same time equally occupied, at least in the hours of leisure. Even under the most favourable circumstances the labour required for pre-eminence in learning unfits a person for the more ordinary concerns of life, and for providing for his bodily comforts, whilst the artificer can enjoy what he earns, if his mind is at the same time so much instructed as to be duly governed.

CHAPTER VII.

THE UNINSTRUCTED MIND.

When a child has been brought up alone, there is no knowledge and no intelligible language. The uninstructed mind has been compared to a sheet of paper or a book, in which nothing has been entered, but in which all things may be written or imprinted. When a child learns words in society, and derives their meanings from familiar objects, and enters on some occupation, which he learns from observing the proceedings of others, he has acquired the most simple education. If he has been brought up with well-conducted persons, he may have copied their modes of life and expression, and pass usefully through his days: but if he has been only in the company of evil-disposed persons, he will have learnt everything that is bad, and if not cut off prematurely, may prove an object of commiseration, and be at length instructed, or be placed under the discipline of a prison. He has had no previous instruction by which he could know the meanings of the words he

hears or utters, and therefore he has no capability of avoiding their repetition and influence.

There appear to be different stages of life in which the brain can receive impressions for instruction. In the first the motions are unsteady, but at length words are pronounced and written, and the brain and mind then begin to act more in unison for more complex displays of their power. Up to about twelve the mind and brain are docile, and although the body has grown, the strength has not been in the same degree augmented: the limbs, however, some time about this period, become stronger with their growth, and if they are properly exercised at convenient times, the mind may remain docile and be easily instructed. About fourteen a greater change takes place, but even then, by an increase of bodily exercise and the sedulous continuation of his studies, the mind will remain docile, and the learning be increased, especially if ambition and the hope of being finally rewarded animate the endeavours. At the periods mentioned, if there has been no instruction and no order kept by an entrance into laborious occupations, the increase of the powers of the body leads only to wilfulness, and the exercise to no useful purpose, but rather to mischief, and at fourteen, when the passions begin to arise, and the organs of the body to grow into excitement, the state

becomes that of an animal in its natural condition, and for increasing and continuing its gratifications, intoxication or other exciting means are adopted; and when all these have grown into habits, the mind and brain have their order and activity for promoting labour almost entirely subdued.

CHAPTER VIII.

THE INSTRUCTED MIND.

It has been the object of the preceding pages to show how the process of instructing the mind in the rudiments of knowledge is usually accomplished. It is now necessary to endeavour to point out not only the manner in which it is advanced to perfection, but how the waste of time and the natural energies both of mind and body may be prevented.

Whatever may be the state in which a person is placed, he must be employed by some means or other, and he will learn the habits of those with whom he associates, be they good or bad. In a small community there is only one kind of learning for all, and it depends principally on the dictates of nature and a few arbitrary laws. But in large assemblages of people in civilised countries, there are various shades of difference usually adopted for each of the numerous classes into which the community is divided. Examples show that the organs of the senses do not suffice for removing this

deficiency of knowledge; but the information they are capable of conveying, and its meaning, must be written on the mind through the voluntary power in connection with the brain in a proper manner. When learning has been proceeded with to however small or great extent, and has then been discontinued, there can be no further increase of knowledge, except through the exercise of the mind and brain in the acts of thinking and memory, according to the extent of the information that has been already received.

It has been stated that the rudiments of learning must be fixed in the mind, and that the brain of youth is more capable of receiving them than in more advanced age. If there be not, therefore, a continued succession of implanting, the brain and mind remain vacant beyond the period at which it has been stopped, except so far as the previous knowledge can occupy it. When it has been left off, there is no employment for engaging the increasing strength of body, and obviating the devices that idleness is always ready to suggest. If he then goes to daily manual employment, his mind has by this early learning been prepared for his duties, and his business is calculated for checking his exuberant animal powers; but if he has no laborious occupation, under the circumstances of discontinuing his learning, his mind leads him to

pleasures for obviating the feelings of weariness and vacuity, and his increasing passions confirm him in habits of sloth and intemperance. If in this state he adopts a profession, he is utterly unfit for more than the mechanical portions of it; for when he comes to enter upon learning the principles of it, and especially the technical phrases, he is quite bewildered. But if, during his youth, besides his moral duties and his other rudimental learning, he has been thoroughly instructed in the Latin, Greek, and French languages, and in numerical and other studies, he has had his mind prepared for any condition of life, and for any profession he may choose to enter, and he has thus acquired habits of industry and application, and prepared himself for a continuous reception of other learning. If the nearly mature man on entering a profession has not received the necessary previous instruction, especially in languages, it becomes a question whether he can then learn them. The time for such exercises has gone by, and it then becomes a conflict between the advantages to be derived from their acquisition and those on which his professional duties are to be founded. If he learns the languages then, he must neglect his professional studies, and the probability is that when he has learnt them, he will very soon forget them, for the progressing cares

of life will not suffer the repetition of such exercises as will keep them firmly engrafted. It is not conceived that the brain cannot accept rudimental learning at a more advanced age, if the entire attention were given to it as in youth, for examples might be furnished in which the acquisition of languages has been perfected, even in old men; but it is an unseasonable occupation, and not to be recommended.

For the acquisition of learning the mind cannot bear to be always strung by attention, but it must have its seasons of industry and relaxation; it must also be humoured in some measure; for neither it nor the brain are the same in all, and therefore they require some variation of the kind of learning to be submitted to them. Attempts at learning may be persisted in throughout the entire day, but it is more than probable that the ear will hear a very inconsiderable portion of the subject, and even the wearied brain cannot accept and fix it in the mind. To expect that the brain can be kept in continual labour is at variance with every man's own feelings, and to expect that knowledge will pass through the eyes and ears, and be accepted without exertion or attention, is a perfect delusion. The more the learning consists of clear facts, and the more they are interspersed with practical investigations, so

that the facts may be sought for and found and imprinted on the mind by his own exertions, the more likely is the attention to be rewarded by a permanent continuance. Numerous lessons brought in succession before the eyes or ears under the supposition that they will be afterwards remembered, is a great mistake; for unless they are imprinted by continued labour of the brain and mind, no true and substantial acquirements will have been established. If the rudiments in each department of learning were properly acquired, although only a short time might be allowed for carrying them out, and perfecting them, they would be ready for occupation whenever leisure happened to be afforded; and if they were never to be practically pursued, the acquaintance with their principles would allow an understanding of the precepts of authors, whenever there occurred an opportunity of consulting them.

As one art or science will not teach another, but all must be learnt separately, so it becomes necessary to consider which shall have the precedence. There is one branch of instruction which is required for every person wishing to make the best use of his time, and that is self-government, or the discipline of acquiring regular, methodical, and virtuous habits, otherwise the course of study will be interrupted

either by the unsettled state of mind, or by objects which tend to waste the time. Lord Bacon* seemed to think this to be one of the fundamental requirements of education. It is especially necessary for those who must provide for their daily necessities. The hungry stomach will always lead to the acquisition of the required sustenance, but this as well as various other appetites and propensities will conduct him without great circumspection beyond the line of prudence; if, however, he is properly instructed in moral and religious principles he will be found to understand his duty, and may thus be kept from breaking the laws, and from the consequent degradation.

As all knowledge must enter the mind by labour, it must be evident that facts and principles are the only things which ought to be selected, and fixed in it by every one. Information received through books, or other sources of instruction, may give a bias to the mind, which may afterwards be with difficulty superseded by any other, especially, the relation of shocking occurrences, which produce fearfulness and a want of self-reliance in darkness, and cause a disturbance of the regular functions of the brain, and lead to disease.

The expression that there is nothing new under

* De Augmentis Scientiarum.

the sun, leads to very mistaken notions respecting learning. As some subjects have a divine origin, and others are derived from the works of the Creator; so, however numerous or useful may have been man's discoveries, they cannot be esteemed as new, only by his fellow man. But they are not for this reason to be less valued, as the knowledge of material things has not been vouchsafed to man, except through the provision in his mental faculties for exploring and determining their composition and qualities. Without mentioning such knowledge as is absolutely necessary for the information and guidance of man in his ordinary duties, in numerous individuals instruction is as necessary for satisfying the cravings of the mind, as food is for those of the stomach. And if this reasonable source of occupation were removed, its place would be supplied by influences which stifle the powers both of the brain and mind.

There is a greater degree of quickness in arriving at knowledge in some persons, than in others, and it has been supposed that through an innate genius men have successfully filled high positions at an early period, as if they owed their success to genius, and not to learning; but this is a great mistake. There has been sometimes a vast acquisition of learning in early youth, but it has too often happened that

the precocious intellect of children has, from too much anxiety about expanding it, prematurely exhausted the powers, so that if death has spared them, they have dropped into insignificance in manhood. Great men have generally arrived at their eminent position by industry. If a man has been uneducated with respect to languages he has been diligent in the pursuits which have produced his attainments and eminence, he may have searched into a great many of the productions of nature with which his profession is more immediately connected, and by combining the results of his labours, may have elicited knowledge that did not previously exist. It will not be questioned that a preparation by the usual acquirement of languages, and the opportunity thus afforded of consulting works on science of every country, must lead to more enlarged views, than personal investigations alone. Unless, therefore, it can be shown that without labour and experience in some way or other, men have arrived at a great proficiency of knowledge, it cannot be concluded that there is more than an exceptional power of becoming eminent in this respect, without the due employment of the brain in connection with mind in reading, and other modes of research.

CHAPTER IX.

ON VACUITY OF THE MIND.

THERE is a condition of the brain attending vacuity of the mind, which is so unpleasing as to produce the utmost desire for being relieved of it. It is the lot of all who are unemployed, but is probably felt most by those who have the command of the greatest leisure and luxuries; it is, however, by no means a stranger to persons of moderate means. It is not a mere emptiness of knowledge, for it belongs to those who have made great acquirements, as well as to those who have made more moderate ones, or none at all. It is, then, a want of present employment of the mind, like the want of exercise for the muscles of a powerful and athletic man who has fallen into confinement. It is generally a wakeful state of the brain ready for exertion of some kind; it probably consists in an activity, if not in a slight vellication of the minute fibres of the voluntary tract in connection with the convolutions of the brain. It may also be

a state of excitement from too much injudicious exertion. It sometimes proceeds to actual thought in reveries, or to an incoherent wandering, and is often attended by unpleasant excited thoughts, and in short, approaches to that condition constituting derangement.

The condition thus described, however wearisome, is a preparation for the active exercise both of the mental and physical faculties. It was intended that such powers should generally be used and not neglected; therefore, by checking instead of exercising them, the faculties of the mind will continue without that progressive improvement which fits a man for increasing usefulness in every new stage of advancing life. This condition shows a capability of exercising the highest degrees of ingenuity, and the attendant weariness is greatest in those who have in this respect the greatest abilities, for many of the cleverest persons have thereby fallen into habits of intoxication. If it is resolutely opposed by an endeavour to employ the mind, there will not only be a great present advantage, but it will lead to the highest perfection in any branch of knowledge, whether in learning or the arts. It is too often the case for a person who has distinguished himself to consider that he has laid up a store of gratification for life, but it is only the commence-

ment of his progress, and the course of study by which he has been so far conducted must be continued; the task will become more pleasant as he proceeds, but he will never attain such a high degree of satisfaction as will prevent the necessity of some share of perseverance. Bodily exercises may relieve these uneasy perceptions, but not entirely. The working man is supposed to be happy when he spends every day in exhausting his energies, and leading him to devote the rest to listlessness and sleep; but he also feels this condition, and too often has recourse to intoxicating means for allaying it.

If this condition is to be remedied so that it may prove beneficial according to the intentions of his being, mental and corporeal exercises should be alternated. When the mind has been properly engaged, bodily exertion will suffice for occupying and exhausting the remaining superabundance of cerebral power. Muscular exertion is a poor substitute for an entire neglect of the mental employment, but it is much more desirable that it should be had recourse to, than to allow wandering desires and reveries to be in possession of the brain. If the brain has already been employed by study during the day, and weariness has succeeded, bodily exercise is most required, or, indeed, any pleasing sight that will give rest and allow the mind to fall

into repose. This condition may be restrained by narcotics and stimulants, but they produce a waste of the mental powers, and at length a gradual failure of the functions both of the brain and the organs of the body. Listless habits first dissemble and then realise a state of impaired bodily functions. The first relaxation from ordinary exercise begins a derangement of the organs of the body, and the first abandonment of mental culture determines the unsettled vacuity of the mind and brain, and both together at length undermine the powers necessary for existence; but a determined exertion both of mind and body adjusted to their several powers will provide against such melancholy results.

It may be presumed that the intellect is always in a state fit for cultivation. It is so in healthy persons, especially children and youths; but when there is an unusual excitement in the system at large, the brain partakes of it, and may have its powers exalted or disturbed for its deliberate exercise; or, on the contrary, if the powers of the system are depressed, the brain may share in this condition, and be unfitted for exertion. A disrelish for exertion may be produced by other conditions of the system, or by the state of the intellect itself through the passions.

Strong intellects may be exerted for a great

period, but the time arrives when the powers of the brain become feeble, and the usual exercise exhausts them, and at length they almost entirely cease. The memory cannot then be further exerted, and attempts at fresh acquisitions of learning will be faintly received by the mind, and be almost immediately forgotten. For some time the brain continues to retain the impressions that were fixed in it in early days, but the more matured and later ones are forgotten. So long as there is muscular power, the features retain some expression, and feeble motions of the limbs continue, and the handwriting, although tremulous, preserves some of its usual characters, and the voice and speech some of their accustomed sounds; they thus form only shadows of a former state, but are expressive of the condition of the mind and brain. In some instances the voluntary muscles become paralytic, from the weakness of the powers of the brain. When paralysis comes on suddenly in persons whose strength has not been thus reduced, although the faculties of the mind had not been previously weakened, they now are more or less interrupted. The extravasation of blood amongst the fibres of the voluntary tract has probably incapacitated them for their free exercise in thinking, memory, or other mental faculties.

When the intellect has been affected for a long time by derangement, there is a gradual decay of the voluntary power. At first it is hardly perceptible, except in some of the finest movements; but at length the larger muscles become paralytic. The first symptom has been a gradual affection of the retina, terminating in complete amaurosis: but it usually commences without any decided change in the functions of the sensitive nerves. It is very probable that it generally begins at the commencement of the voluntary tract, near the connection of the fibres with the convolutions, and is caused by the consequences of the previous over-excitement, which now prevent their free action.

CHAPTER X.

EXCITED CONDITIONS OF THE BRAIN AND MIND.

In the preceding pages the brain and mind have been considered in deliberate action together and with the organs of the body, for producing their ordinary state of activity; there are, however, other conditions of excitement and depression, which require some notice. The mind itself has the power of increasing or diminishing its usual exercises; and when these are taken beyond a certain point they cease to be acts either of exertion or listlessness, but those of excitement and depression, different degrees of which may be considered as constituting the passions. But, besides the acts of the mind itself, similar conditions are produced through the state of the organs of the body and the quality and circulation of the blood.

The actions of the body may be controlled or disturbed by the faculties and passions proceeding from the mind and brain. The aggregate powers

thus produced in connection with the brain and nervous system and the organs of the body, give a general inclination to certain healthy or morbid conditions of excitement or depression, which may be considered as forming the idiosyncrasies of every individual. The exciting and depressing passions produce their general influence according to the extent and quality of the sensory; also according to the structure of the organs of the body, the quantity and quality of their nerves, and the mode of their supply of blood.

When the powers of the nervous system are raised or depressed through the several faculties of the intellect there is a peculiar state of the cerebral fabric. A mean condition, bordering on a state of quietude, in which there is nothing to be absolutely avoided, approaches the nearest to health; but it seldom continues long without some encroachment from the too-prevailing influence of the appetites and passions, according to the temperament of the individual. Although there are different shades of several passions, and some of them border on those of others, yet either the exciting agency of the one or the depressing influence of the other is generally in the ascendancy, and consequently those of an opposite tendency are seldom in activity at the same time. It is probable that the most calm and

healthy feeling lies in the balance between them. The exciting and depressing passions approach to joy or sorrow, and produce exhilarating or uneasy conditions of the system. From whatever exciting passion joy proceeds, it especially heightens the corporeal faculties, but is too exhilarating to be continued long without disturbing them: gladness, which is a more moderate quality, and hope, may remain long, and induce only a salutary activity both of the intellect and body. Whether joy begin in the mind or arise from corporeal ease, it produces an energetic condition of the brain and nervous system, and a corresponding activity of the circulatory and respiratory organs. Several qualities of this passion are mental and cannot be comprehended by animals. Sorrow, anxiety, fear, and despair may depress all the functions of the body, according to their degree and endurance, and enfeeble the nervous fabric, and with it the respiratory and circulatory organs, by diminishing the oxygenisation and supply of blood necessary for promoting a healthy activity. In anger, with courage, and a determination for action, there is a heightening of the faculties of the brain and nervous system, and the lungs and heart, but in violent or continued anger the same powers become exhausted, and then form a state of depression.

Anxiety and fear may convey irritation from the mind to the whole brain or particular centres, as those of the nerves of the limbs, so as to impair their activity and produce pain. The desire for exercise is not very distant from the passions; it produces an energetic influence, unless it be carried so far as to cause exhaustion. Energy of the mind also produces a cheering influence, which may be extended to the organs of the body, and bring these to act in accordance with it: the will may then also be stronger, and the muscles more disposed for activity. If there has been more exertion than is consistent with the easy condition of the organs, an inordinate excitement of the nervous system and the circulatory organs may be produced.

Accordingly, as each passion raises or depresses the vital forces for a longer or shorter period, if the excitement is very great more blood is given to the brain and sentient parts and less to the secreting organs, so that the secretions become scanty and the appetite for food is diminished: but when the influence of the excitement has abated, the appetite returns, as a necessity is then created for restoring the previous waste of power. When the condition of the passions is moderate, neither the functions of the brain nor of the viscera are

interfered with; but when they are depressing, the brain is deficient in energy, the respiration becomes slow and the circulation feeble, and there is a congestion of the veins of the viscera or skin if the secretions are not increased.

The appetites and passions are common to animals with man, as those appertaining to food, reproduction, affection, and hatred. They may be provoked through the senses or the excited organs of the body, but in man they may be reproduced through the mind. From the manner in which the passions have been implanted, and the limited power of the intellect, animals are kept within prescribed bounds, so that they cannot, like man, through his mental ingenuity, invent various modes of provoking unnatural appetites, or of magnifying inquietudes; for if they have a large appetite and great digestive powers, they have a way of disposing of the nourishment, either through exertion or in convenient modes of deposit; and if these are not sufficient for consuming or containing it, the appetite diminishes. When, however, they are tempted by food artificially prepared, they form a growth which sooner or later becomes as prejudicial to health as to the free exercise of the body. Passions of animals are seldom of long continuance, and in many instances only periodical:

they generally at other times cease soon after the immediate object of attachment or resentment has been removed, or the excited condition of any organ of the body has subsided.

Animals have their passions circumscribed, as they have not reason to guide them; they are only brought into subjection under the influence of man. In the greater number of animals the most exciting appetites observe seasons, and then they are almost entirely incapable of being controlled. Man, however, has rule over all these conditions, and, if his mind is properly cultivated, he will encourage or restrain them, so as to keep them within due bounds. The mind depends on the brain for its means of instruction, and power of exercising its authority over the body; and the body can re-act on the brain so as either to enhance its faculties or to weaken and subdue them. Every one has the capability of regulating these changes, which daily occurrences are always altering. The wealthy cannot indulge in luxurious living and ease with impunity, neither can the poor be kept capable of working with a too scanty means of sustenance. By careful attention it may soon be discovered how a person ought to live, and how he ought sometimes to change his plan. At times the mind is oppressed through too great a circulation, and the uneasiness

is removed by diminishing the usual supply of nourishment. More food and stimulating drink, in some cases, are required for keeping the circulation brisk and steady enough for sustaining the tone of the more active portions of the brain. There can be no fixed rules for these changes, and therefore a determination to keep to any kind of diet, or mode of refreshment, is untenable on principle, as far as regards the health and activity of the mind and body. Habits of luxury allow great exertion for a short season, and then lead to dulness and apoplexy; habits of too strict temperance diminish the tone of the brain, and therefore weaken the mind, and lead to disorders both of it and the body. Each kind of regimen may agree with persons of opposite conditions of constitution; but there are very numerous exceptions, which are ever varying with circumstances of age, health, anxiety, and care, and the depression incidental to situation and the condition of the atmosphere; and therefore the rational plan lies between the two extremes, so that all the things which have been provided for the use of man will be advantageously partaken of in proper seasons, if they are employed with moderation.

CHAPTER XI.

THE MIND AND ITS CONNECTION WITH THE BRAIN.

The spirit forming the mind cannot be compared with any portion of the elements of the material world. Man feels assured that he has a mind, that he knows its faculties, and that he perceives with it, thinks with it, reasons with it, judges with it, determines with it, and acts with it and through it in all voluntary motions. Although it differs from every kind of matter, it agrees most nearly with that constituting the brain and nervous system, but requires for its connection with this to be animated by the nervous element or essence, which must be sustained by blood, or other fluid containing oxygen. It is then capable of intellectual exertion, and of acting with the organs of the body, whose equable functions promote its agreeable perceptions, and constitute health; and their disturbance, in different degrees, disease. When, from the failure of one or more

organs, the balance of the whole ceases to be maintained, death takes place.

The mind and brain have their respective peculiarities when separately considered, and they have agreements for conjoint functions. There is a perception of the brain received through sentient organs, and responded to by reflex muscular action; and there is a perception of the same in connection with the mind; there are also perceptions of the mind itself, independently of the sentient organs. There is a reception and fixing of symbols, letters, words and figures, by the brain in connection with the mind, and there is a reception of their meaning by the mind itself. The brain receives impulses from the excited organs of the body, and then influences the mind. The mind receives exciting impulses from other minds, and from excited changes or passions of its own, and then, in its turn, influences the brain. There is a memory after the amputation of a limb through the brain in connection with the mind; there is also the same in recollecting symbols and letters, and likenesses of men and other objects; there is also a mental memory from thinking. The faculties of the mind are only powerful in a state of consciousness, but those of the brain are so also in sleep; both must act together for many purposes, and for few they

can in reality be separated, and probably never entirely in the perfect being.

The brain is so ordered that it may be duly apportioned to the various powers it has to promote in subservience to the intellect, and the different parts of the body with which it must co-operate. The convoluted surface ministers principally to the intellect; the sensitive tract occupies only a small part, but the voluntary is very extensive. These, on account of the high faculties they promote, constitute in a considerable degree the powers of the active being. The involuntary tract occupies a much less part than the sensitive for producing a gradation from sensation to perception, and from voluntary to involuntary motion, but sufficient for the organs it supplies, and for acting with the sensitive and voluntary nerves for the almost perpetual functions relating to the formation and purification of the blood, and the various expulsive acts for removing extraneous matters. The sympathetic nerve has the smallest participation of its influence, and this is so minutely subdivided as to allow a very low perception, and an entire automatic action; the organs it supplies are, therefore, assisted for an occasional increase of power through its connections with nerves having higher qualities. By the extension of the sensitive,

voluntary, and involuntary tracts through the spinal cord, by the size of their nerves, plexuses, and ganglia, and by the peculiarity of the sympathetic and the modified structure of the organs, the necessary communications of the body with the brain have been secured for the harmonious functions of the whole.

In man the brain anteriorly is very prominent; the posterior lobes are narrower, but very much lengthened. The brain of animals, when compared with it, appears as if a considerable portion had been removed anteriorly and posteriorly, and more or less in the median line.

It has been previously stated that behind the anterior third of the summit of the brain, and an inch from the median line, the appropriate convolutions of the involuntary tract are placed; and behind them, in the same line, the convolutions of the sensitive tract. The most anterior portion of the sensitive tract belongs to the sensitive parts of the spinal cord; the next to the sensitive half of the larger portion of the fifth and the auditory nerve, the most posterior to the optic nerve, which extends underneath the epithelium of the posterior and descending horns of the lateral ventricle, and towards the anterior part involves the roots of the olfactory nerve.

There are the same fundamental parts of the brain of man and mammalia in some degree according to the size of the animal, but especially according to the extent of the intellect. The voluntary centres occupy a considerable portion of the lateral region exterior to the involuntary and sensitive tracts. In animals the median region diminishes with the great commissure, which in the lowest forms a mere line of contact between the two hemispheres; and in the same degree the extent of the intellect becomes lessened. As everything is done in the strictest order when impulses arrive from the organs of the senses in animals as well as in man, they can be conveniently taken to the voluntary centres placed on the outer side of the sensitive tract, for actuating at once any of the muscles necessary for answering them. The more median region lying on the inner side of the sensitive tract, and including the inner and inferior portion of the posterior lobe, may be considered convenient for the more mechanical functions connected with the intellect, which do not require any immediate muscular action for their control, as for storing resemblances of objects, places, sounds, letters, and symbols. It is presumed the same may be done in some other parts if further room be required for persons who have made very extensive

attainments. Without this explanation it is difficult to understand why the involuntary and sensitive tracts are placed between the two layers of the voluntary tract. The more frontal portions of the brain are adapted for special intellectual functions relating to the processes employed with the mind in thinking, memory, and the meanings of words and sentiments; for although such acts involve the attention of the whole sensory, there nevertheless are particular portions destined for especial purposes, and they may be conducted there with the consent of the entire intellect.

As there is one portion of the brain set apart for receiving impulses from all the organs of the senses, another for volition, and a third for involuntary motion, so there may be a fourth for storing letters and images, and a fifth, more separated in the frontal region, which can assist in the act of thinking and remembering, for allowing the mind to be engaged in a considerable degree without the interruption of the mechanical processes carried on in the other regions, but still so in harmony with them as to enable it to use them for promoting its own purposes, either in recalling letters and images, or at the end of its deliberations in actuating the required muscles for speaking or writing. Notwithstanding these separate functions in different parts

of the brain, the sensory is cognizant of the whole, but the mind judges and determines respecting everything relating to itself; and although it has a certain degree of command over all the processes, even over the involuntary and sensitive, it has not by any means an absolute power, except in those things which are strictly mental, and in this respect not at all in sleep.

When a person reads some formal writing, it is taken directly from the eyes to the sensitive tracts, and thence to the motive centres on the outer side of the brain, for actuating the muscles of the tongue and lips, and this he does quickly; but if the mind is also employed in thinking of what he is reading, he uses likewise the frontal region, and the entire sensory is attentive: he then speaks with deliberation. If he writes, there will be the same processes with respect to the mind, according to the difference of merely copying, or of considering also the meaning of what he is writing. If he is engaged in an ordinary mechanical work, or a very nice one, which is to be executed for the first time, there will be the same kind of difference. If he is employed in thinking only, this may be conducted in the frontal region, the whole sensory being attentive, the letters, words, and images required to be referred to, being ready to be given up or used in

the process: whilst the result, as the meaning and sentiments, remain in the mind itself.

The whole of the convolutions forming the sensory promote all the intellectual functions, receive impulses from the external senses, and excite and control the actions of the muscles. The sensory is not sufficient for combining the immense extent of white fibres connected with the voluntary tract; a very considerable number is extended through the great commissure for producing a consentaneous action between the two hemispheres, but by far the larger portion, belonging to a single hemisphere, tends towards the circumference of the oval receptacles near the striated body, and is there admirably disposed for concentration in a moderate space, for allowing, in the most convenient way, some to perform separate functions for actuating more independent voluntary muscles, and others to communicate for combining parts which must act together for consentaneous operations. This mode of concentration and arrangement is more especially required for carrying out the results of the faculties of the mind in connection with those principally destined for actuating voluntary muscles. The sensory can direct the will from distinct spots in the exterior region, but particular means of combination are also required for more mental parts acting with the

muscles, which are not entirely under the same command of the will.

It has been stated that there are special fibres from the median region, where letters are imprinted, which are continued towards the striated body for joining those passing to the nerves of the muscles of the hand for writing, and the tongue and lips for speaking. Such an arrangement appeared necessary for combining the mental with the common voluntary properties, and that it would take place conveniently at the margin of the oval receptacles near the striated body. By experience these tracts of both kinds become used to acting together, and the impulse of the will directs them unerringly to the completion of writing or speech. What is physiologically necessary for the proper combination of the mental and voluntary tracts, is confirmed by the changes and defects produced by an extravasation of blood amongst the white fibres, or by other disorder of the brain attending paralysis. By such means the connection between the median region containing the imprints of letters and words, and the voluntary tracts destined for the nerves of the hand, or of the lips and tongue, may be so much interrupted, as in some instances to entirely sever their necessary communication, or in such a degree as to produce confusion. The general memory may be

impaired, or the special memory of words, the median region where these are implanted being very much implicated in the injury. If, therefore, the tongue and lips, and vocal organs remain perfect, there may be either a total suppression of words, or a confusion and misapplication of them. If there be the use of the right hand, and the voluntary powers are sufficient for moving it for writing, there is a failure in the remembrance of words. It must therefore be evident that besides the voluntary powers of the tongue, and lips, and hand, there must be another superadded from the region where the letters and words are imprinted, and whether the injury takes place in this, or in the regions where he voluntary and other faculties are produced, or in the tracts leading from them, the necessary links are broken for perfecting their usual functions. In confirmation of these observations numerous facts are to be found in esteemed authors.

The light itself is admitted through the optic nerve to the brain, otherwise the letters would not be perceived. It is the light at the margins of the dark letters, and it has appeared that it is similar in the hexagonal facets of some insects, the centre being dark, and the light streaming in through narrow partitions at the hexagonal lines. When there is a black ground the light in the centres of the letters

may be admitted, whether they be red or white, or any other colour having sufficient brightness. Letters reach the sensory through the eye in this manner, or through pulses of the air, modified by the ear, and are perceived by the sensory, and for the convenience of retaining them, are fixed by the voluntary tract in the median region near the sensitive tract. It may seem to be superfluous for words to be fixed in the brain, but if they were not, there would be neither distinct language nor a continued similarity of handwriting, but a confusion of both. When they have been imprinted on the brain they cannot be expunged, but are always ready for use according to necessity, and can be taken by the mind and conveyed through the muscles for speech or writing, whenever the thoughts are to be communicated to others.

When man is compared with all animals, he has by far the largest brain in proportion to the spinal cord and is thus made capable of the greatest satisfaction and enjoyment, probably, in some respects, through the exquisitely-formed organs of the body, but infinitely more through the faculties of his mind. He not only has continual opportunities of receiving fresh mental gratifications, but of expatiating on those he has already accumulated. When his mental powers have not been exercised, he approaches

in some degree to the condition of animals. A monomaniac has one dominant idea; it may be that of revenge, like the spider; that of savage and voracious rapacity, like the wasp; of carefulness, like the bee; or of avarice, like the ant; and for one or other of these propensities men of sound mind often sacrifice all the other powers of their capacious intellect. When the powers of the brain and mind have been suffered to become contracted, it is difficult to erase the single idea which has so long had possession of them. Man thus descends to the condition of animals, but they never can ascend towards man with a cultivated mind. A good education, and the employment of the mind in some useful pursuits as life proceeds, are calculated for checking this lamentable neglect.

CHAPTER XII.

SOME SENSITIVE AND VOLUNTARY PROPERTIES.

SENSATION is formed in the several organs of the senses, and is completed at the connection of their nerves with the sensitive tract and the appropriate convolutions in the sensory. All the sensitive impulses are so fleeting as to be almost instantly forgotten, unless they can be imprinted in the sensory by a voluntary power. Continued pleasurable perceptions of all the senses would engage the entire attention, and leave no opportunity of cultivating the mind or even of filling useful occupations, and unpleasant ones could not be endured; besides, the organs must have been multiplied, as the same could not have tasted bitter or sweet in such quick succession as at present, and smell loathsome or delicious scents. It is therefore necessary that sensations in general should be evanescent, unless some qualities of them can be determined by outlines, so as to be fixed on the sensory in the form of letters and words, figures

and other objects. The sensitive tract has a much smaller connection with the sensory than the voluntary; it conveys all the impulses necessary for the information of the intellect, but when it has taken them to the sensory it is very slightly concerned in their further disposal. When sensitive impulses have been fixed in the mind this may be able to recall some qualities of sensitive images, but only such as have been well defined.

The sensitive nerves, as those of smelling and tasting, receive qualities which are entirely evanescent, and any remembrance of them can only be produced by a repetition of the application of similar scents or savours. Those of seeing, hearing, and feeling, are capable of renewal through the mind, because light and air can be limited by outlines for representing objects; there is not any remembrance of abstract light, air, or pressure, but of the marks or forms only which have limited them for acceptance. If the intellect could have been instructed merely through the organs of the senses, little labour would have been required; but as such cannot be the case, shows, pageants, and other pastimes become like dreams, unless they furnish ideas that can be fixed on the mind.

If the organs of the senses noticed all impulses they would become weary by the necessary attention,

and no room would be left for choice. It is, therefore, wisely determined that only such as are required can be accepted by the intellect through a voluntary effort. The organs of the senses are constructed for conveying diminutive proportions of large objects presented to them. The brain is then informed correctly of their qualities, but their extent and size can only be determined by comparison or measurement. The extended surface of the brain of man does not seem compatible with the mere admission of a few minute objects, but for allowing a great number to be selected and placed conveniently in the sensory for recollection.

Every impulse received by the sensory is either deliberately attended to or discarded, and is answered or not by voluntary muscles. But in sleep there is no opportunity of judging of the quality of the impulses, and they are conveyed without the consent of the intellect to the voluntary muscles. The intellect has therefore in its state of consciousness an independent property of resisting impulses, and showing its superiority over every material power. If the brain had been constructed of equal portions of perceptive or irritable matter, and one was capable of answering impulses received from the other by producing a contraction of muscles, a great power might have been manifested, but this

is not the principle on which the intellect governs it, as it would be at variance with the voluntary and other elective properties especially required for deliberate proceedings.

The voluntary faculty is employed in all arts for instructing the mind, as well as for actuating the voluntary muscles, and as the powers of the mind are very great, and much activity is required, a large proportion of the brain in man is occupied by the voluntary tract. An effort of the will is accompanied by a consonant act of the sensitive tract. The organs could not be adjusted if the will alone were engaged, for as soon as the eye is to be used the light is admitted, and the muscles bring it to a proper focus; the muscles are prepared along with the retina. If it be wished to walk the optic nerve is roused, as well as the sentient nerves of the skin, and the ocular muscles combine in the action with the other muscles. Unless there be sufficient light the will cannot direct the eye correctly to an object, nor yet the limbs, and then the continuations between the sensitive and motive nerves become very necessary, as the way must be felt at every attempt at progression. If the hand is to be moved in writing the skin and retina are in immediate activity, as well as the muscles of the arm and eye. Cuvier* says,—"If

* Anatomie Comp., tome ii., p. 442.

we cut out or cover with opaque matter the eyes of a dragon-fly, it will strike against the walls in its flight. If we cover the compound eyes of the wasp, it ascends perpendicularly until it completely disappears. If we cover its simple eyes also, it will not attempt to fly, but will remain perfectly immovable."

When muscular power is used it is seldom that one organ of sense suffices for assisting it: feeling must always accompany the muscular action, otherwise its force could not be estimated, but the muscles require direction from one or both of the senses of seeing and hearing. A blind or deaf man can walk, but it is with fear, especially in the blind; they can perform various mechanical operations with the muscles, but they must be of a particular kind, and capable of allowing deliberative action. But for the ordinary concerns of life the sight is required for the free action of muscles.

Although the will has in itself so much power of acting, many subordinate offices connected with it are performed through the assistance of the external senses. It is generally assumed that the will directs the motions of muscles at once, entirely through its exciting influence; it can do this according to the knowledge the intellect has previously

acquired for more limited motions, when it knows they can be performed safely, and without obstruction, but even then, it must be accompanied by the assistance of one or more of the senses. If food is put into the mouth it can be masticated with only feeling, but when a limb is to be moved there must be also the assistance of sight for showing that the organ has a clear and safe course for completing its operation, but in a blind person it suffices if the hand through a stick feels that there is a firm footing.

The shapes of the organs of sense tend very much towards determining the force of the surrounding muscular actions, but there may be some misconception on this head. The impulses from an organ of sense must first pass to the brain, and be impressed there by the voluntary tract; the muscles may then be excited, or not, by the will for commencing a succeeding operation, when the same or another organ of sense must determine the direction of the action, or its strength, at the precise part in which its force is required to fall.

If the image of an object has entered the eye, and become impressed on the mind by the voluntary tract, the eye has completed a first stage of sensation; the second stage must be begun by the will for writing it, when the eye directs the hand in

placing the words on paper. In this second stage the assistance of the eye is not the cause of the transference; but an adventitious help for placing or writing the image on paper, in a proper situation, and without any obstruction to the motion of the hand and pencil. An experienced person can write without the eyes, for the letters are already impressed on the brain, and if the will excites the muscles of the hand for writing them, the eyes may be shut, and the direction furnished by a ruler, but then the act is accomplished with much more deliberation. When a person is blind the reading is performed after feeling with the fingers the embossed letters, and in the same way the writing is directed by feeling a ruler.

When a sentence is heard, there is a complete act of the organ of hearing, and if it is regarded there is a complete act of the voluntary tract in imprinting it on the mind, and thus the first stage of sensation is completed. In this condition it may either remain fixed in the memory, or fade away. If it is to be spoken, the will directs the muscles of the tongue and lips to commence the second stage, when the organ of hearing, by which the impulse was received as the principal in the first stage, is now employed only in the capacity of witnessing the act of speaking and directing the tone and pitch of the voice, and

then the second stage is finished. When a person desires to remember the likeness of any one, after the image has entered his eye satisfactorily, there is a complete act of the organ of sight, and when he has fixed the form and features in his brain and mind the first stage is finished, and he may remember and continue this perfect in his mind, or forget it. If he then, or afterwards, wishes to delineate it, he begins quite a new act, and then the eye is only an assistant, or guide to the hand or pencil for making the lines proper with respect to their place in the paper or canvas, and thus the second stage is finished.

If very complex actions of the senses and limbs, and other organs, are employed, the mental ones are more or less suspended, except as far as they are engaged in the direction of the present operations. The sensory can only allow a certain amount of impulses to be received or conveyed from it at the same moment. Several of the organs of sense and motion may be concerned in action together; but their proceedings must be sufficiently gentle and agreeable for all of them to be accepted and promoted by it. When the thoughts of a person are engaged in hearing a discourse, the ear will be chiefly concerned; but the eye or other senses may be also interested harmoniously, if illustrative representations in unison with the words are

brought under notice. When a person sees, hears, sings, and plays with the hands, or dances with the feet, there is a great combination of the senses—the voluntary and involuntary powers; but the actions of the whole, if moderate, are well sustained. Nevertheless, no individual action is then so distinctly performed as it would have been separately with the entire power of the intellect. If the impulses received from one organ of sense, or the actions of one set of muscles, be much greater than the rest, the stronger will command nearly the whole attention of the intellect; the weaker will probably act in sympathy with the others involuntarily. In complex actions, therefore, there must be a few quick, violent motions of several limbs together, as in dancing, running, and mechanical pursuits, and very little employment of the intellect. If a person dances and plays on an instrument, or if he dances and sings, the sounds will be strong in correspondence with the motions of the limbs. But for any of these accomplishments to be perfect, they must be performed separately; when any other nice mechanical operation is to be employed, no other can be at the same time conducted. It may be presumed that these acts are performed entirely through the brain, and although this organ is in a great degree concerned

in giving power to the parts employed, and in completing their combinations, there is a great complexity of organs necessary for their perfect accomplishment; and they are actuated by the sensitive, voluntary, and involuntary nerves, according to the explanations given in speech and writing.

There is not a greater perfection of human art than in the harmony produced by many hundreds of voices and instruments in singing the same song and playing the same tune. When it is considered that the notes, if not already in the memory, pass from the eyes and through the mind and brain, and the will in all actuates in the required degree the respiratory organs, the mouth and lips, or the hands, or both; the nicety, and perfection, and similarity of action through the mind and brain at the same instant, is extremely interesting. It shows that the powers of the mind and brain are not very different in the numerous performers; otherwise they could not be united with so much precision in producing the same activity of the eyes, and ears, and organs of feeling; the same activity of corresponding fibres of the voluntary tract for actuating the muscles of the lips and tongue, or those of the hand, and sometimes also those of the feet; or in controlling the involuntary acts of the respiratory muscles, and in producing a necessary activity of the other muscles,

for holding the body firm, and allowing a free action of all the various parts concerned. The same harmony is shown by a large class prepared for reciting any composition, as when one begins, and another continues, the thread of the subject. In a more mechanical way it is shown by a number of persons dancing to the same tune, and in soldiers firing with so much precision at the word of command. These several processes show how the mind and brain might be educated in the young for producing simultaneously public order and usefulness. The obedience of horses in troops is also orderly; the ploughing and drawing of horses, the command over sheep, and that over dogs, especially for field sports—all show how the actions of the brain may be brought into obedience even in animals, particularly by the command of the human mind. But when the mental accompaniments of the movements of the men are considered, their superiority is very evident. The understanding of the words and sentiments produced by singing and music, the repetitions of boys, and even the ultimate end and aim of the firing by soldiers, could not be comprehended by animals; for all their order and evolutions are mere imitations produced by observation through fear of the whip, spur, or other mode of coercion.

CHAPTER XIII.

THE INSTINCT OF ANIMALS.

The instinct of animals is sure to arrive at perfection with the full growth and uses of all the organs of the body; it qualifies and sets bounds to the passions, it is often mature very early, and capable of more ingenious devices or mechanical contrivances than the uninstructed child ever attains to. It is modified by some differences of the proportion, form, and quality of the brain, and also by the various processes of the body, and by the quality of the blood, food, and education. Changes in all these respects contribute to the special intellect of each animal. The quality of the blood and the organs necessary for furnishing the materials from which it is formed lead to fierceness, and in other animals a different quality and mode of obtaining its replenishment lead to quietness. The peculiarities of the brain, the employment of the external senses, the will and desire for motion, the condition of the muscles, the fitness for living on land or in water,

and the changes of the reproductive organs produce differences of perceptions and habits in various individuals.

Man, in his natural state, approaches the condition of animals entirely instructed through the organs of the body; he has a much greater capacity, but is, nevertheless, very slow in acquiring knowledge through his unassisted powers. In animals, generally, there is very little more information than leads them to supply their necessities and agreeable exercise. They have their degree of intelligence depending on the brain and the organs of the body, and every species has some difference, which may be well observed in the varieties of the horse, one of which is fitted for strength, another for fleetness.

Many of the instinctive faculties or propensities are connected with the reproductive organs. In fishes there are some remarkable peculiarities, but the body does not produce them, nor the brain, but the reproductive organs in connection with the whole. Birds make various kinds of nests, but when they have a decided form, it is round like the eyes; they change their habitations in one climate for those in another, they have otherwise no foresight, except what arises from the reproductive organs in a particular state of excitement, and in particular instances none from these. Some of

the mammalia have peculiarities, but they do not seem to have the same foresight with respect to reproduction as birds, except about the time of producing. This change also forms one of the most remarkable peculiarities of insects.

Animals through their intellect are guided to the provision of food, shelter, and defence, and the understanding of surrounding objects, and when under man's influence and discipline become acquainted with other observances. Such information as they receive by the senses and understanding, or are made to feel the import of by coercion, or acts of kindness, they fix in the sensory and remember, and thus especially can be made to understand and obey words for turning or quickening their paces. Birds can pour forth songs, or even speak the language of man; they may also be able to attach the meaning to some expressions acquired from observing the objects they represent, and these are the most remarkable imitations of human powers the animal kingdom presents to notice. They cannot, however, understand what in man is the mental meaning of words, and cannot thus substitute one for another, but utter them in the order they have been learnt. The condition of the child without further instruction than that it derives from companions and familiar objects, is somewhat like that of the acquirements of animals

already enumerated; there is nearly the same use of the intellect as far as it relates to necessities, the avoidance of danger, and the desire for exercise. The quicker maturity and more strongly implanted instinct of animals place them in a somewhat more forward condition with respect to mechanical contrivances. But the analogy between the intellect of the child and that of the animal soon ceases, for the youth without much more teaching may arrive at a mechanical dexterity beyond that of all animals for supplying his wants and for guiding himself correctly.

Although the brain is very small, the intellect, in some respects, is as acute in the lowest animals as in the highest, and there is an equal nicety of sensation and volition for minute operations. The more extended brain of the highest animals admits of a greater number of ideas, and a greater degree of sense and motion, in correspondence with the larger size of the sensitive organs and muscles, but the animals most resembling man cannot either use their tongues, or lips, or hands, for the resemblance of language attained to by parrots, or the mechanical contrivances of the bee, or wasp, or spider, their agility and grimaces, are very remarkable, but in many instances a very slight mark of intellect is combined with them.

Insects have two or three ideas predetermined and fixed through the repetition of processes which gave rise to them, as the bee in getting honey and storing it; the spider in making its web and watching for its prey; the ant in laying up its future provision of food; and the wasp in its ferocious gluttony and making provision for its offspring. They have a very small brain, but enough for their degree of intellect, and for animating the muscles. The bee by its smelling is led to honey; other insects are led to particular animal or vegetable substances, where they lay their eggs, and these, when hatched, acquire a smell and taste for their particular food, and thus, in their turn, seek out for similar provisions for their offspring. Many things presumed to depend on instinct have precise mechanical causes, and are to be found in the organs of the body either in their general mode of acting, or when they are brought into activity for especial purposes.

Even should the causes of the several instinctive faculties of animals be found out and traced to the activity of some of the organs which compose their bodies, there still remains an amount of intellectual power, the result of the instinct and the organs combined, and showing a degree of sagacity, which must remain one of the secrets of creation. Every animal is an assemblage of curious contrivances, but their

intellect cannot approach the mind of man; they may have a resemblance of the will, sensation, involuntary power, respiration, and circulation, and their several organs answer to the same in man, but the comparison must end in the form and physical powers, and a dream of intelligence. All knowledge has been either produced or recorded by man, and animals have not contributed even an atom to it, and this must be enough to convince any one of the difference between the mind of man and the instinct of animals, without going into any of the other numerous reasons that might be successfully produced.

In the animal economy from man downwards, there is a gradual descent in some respects only, and not in all, for it may be in one way in one animal, and a different way in another. Thus in the highest there is a large brain and some high faculties, especially with respect to sense and motion, and in all other properties the nervous system is nearly as complicated as in man, and many of the organs of the body are also as elaborate, but those directed by the mind are very superior in the great variety of their functions. If the brain becomes much smaller there is an inferiority of intellect, but not of the rest of the nervous system. In insects there are different degrees of intellect, and varied

shapes of the nervous system, but this is not inferior, but only modified in form to suit the general structure of the body, and is ready for higher or lower functions accordingly as the organs are capable of making peculiar impressions on it. In vegetables there is also a great variety, but not in the same way, for some appear almost more intelligent than animals, as the influence of light over them may be greater than the very limited nervous system is over animals. When the use of the legs or also of the arms has been lost, the trunk of the body and limbs seem almost as if they did not belong to the head, for the intellect may be quite perfect, but the state is as much changed from the former condition as one animal with a differently-shaped body varies from another, when the brain and intellect are nearly the same. Therefore, however distant the forms of animal bodies may be from each other, there may exist some high qualities of the brain, and an acute intellect, with the rest of the nervous system and the several organs as low as in creatures still inferior, and this may be observed in cetaceous animals, and especially in the porpoise.

It has been stated that much of the instinctive ingenuity of animals is derived or reflected from their organs, and especially those of the special

senses, and the reproductive. The insects which show these powers in the most remarkable manner are not fitted for showing any other faculties, or for changing their mode of living. Animals adapted for the use and assistance of man must approach him in a higher degree, and must have their intellect so much at liberty or so independent as to be able to accommodate themselves to his requirements. If they were provided with the brain and intellect as in insects, this could not be effected, nor even if it were like the lowest of their own class, for they could not be turned out of their limited path, and be taught or coerced into anything like obedience, for riding, drawing, carrying loads, hunting, or guarding. Some animals have therefore been furnished with a large brain that their intellect may approach sufficiently near to that of man, but still be so confined within limits as not to be capable of being exceeded, except in a small degree.

The more savage animals may seem to form exceptions to the advantages of those having large brains, but although the faculties and powers of the strongest of them can probably never be put to any available use, they are infinitely more amenable to the superintendence of man than if they had very small brains, and the same means of destruction. Their large intellect leads them out, and brings them

nearer to those animals most obedient to man, and they can be pursued, hunted down, and destroyed, or avoided much more easily than if they had been always lying in wait, and were never roused until their victims came within their grasp.

There is a small species of those fierce animals in the common cat, and it cannot be conceived that the same occupation could be effected with more intelligence in conformity with domestic economy. Although it is kept in society by care and kindness, it is nevertheless fitted for a wild life, to the consternation of gamekeepers. By its size it remains under the control of man, but the larger species of tigers and lions have so much strength that man's force is seldom enough for overcoming it, and their savage demeanour leaves no room for parleying and caressing, unless they are confined in cages,—and, therefore, as there must be always force opposed to force, man never meets them except as a destructive foe. If giants existed as much superior in size to them as man is to the cat, they no doubt might be tamed in the same way.

Such animals as give the greatest help to man have the largest brain, as in mammalia; and as the brain diminishes in size, they are more fitted for his food, and some that are of no use for their strength or for food, supply him with skins and hair.

Although birds have some quickness, he seldom makes use of them except for food and feathers; and the same may be said of amphibia and fishes. As the highest approach man the nearest in the size of their brain, their organs of sense are perfect, and they are able to observe and fix some of the strongest and most remarkable impulses for remembrance. As these qualities diminish, the brain becomes smaller, even in the same class, and in birds and in amphibia and fishes it is very small, —in the last two classes, although there are similar organs of sense, their perceptions are very low, and few of them are required to be remembered.

In birds and amphibia there are the fewest variations in the organs of the senses, so that throughout each class there are similar objects to be noticed. In mammalia and fishes they vary more, and there are more marked differences of the required modes of living, and the places they occupy. Although there is such a similarity of construction in the four classes, they are not all capable of accepting the same impulses, or they are of a very inferior quality. The perceptions are nearly the same in mammalia as in man, and not very different in birds, except in the power of tasting. The hearing is as good, as they can speak and sing. In amphibia the senses may be perfect

for certain impulses, but they are dull when compared with those of birds. In fishes the organs are delicate, but probably do not notice more than a few common impulses. In all the classes the organs are principally constituted for leading to the supply of the wants, for directing the limbs in locomotion, and avoiding danger.

If the higher animals with a large brain are capable of receiving not only more numerous, but more exquisite impulses than the lower by their smaller brain, the higher requires a larger voluntary tract for fixing such as are to be remembered. In mammalia, the voluntary tracts are in a considerable degree for actuating the muscles, for moving large and heavy bones, but some portions are also required for the sensory, for fixing such things as are necessary for guidance either in their travels, or work, or in procuring food. As the faculties of each animal become lower, the brain is less, and not so much of the voluntary tract is required for fixing the impulses received from the senses for remembrance. Those having the largest brain make more observations, and require more extensive voluntary powers for fixing them. Cetaceous animals have a large brain on account of their necessity for rising perpetually out of the water to breathe; and for

this purpose as well as for getting food, and for locomotion, much intelligence is necessary. The elephant has great motive powers, and much intelligence for directing them. The ox has great locomotive powers, but not near so varied as in the horse; his brain is less than in the horse, and his intellect more confined. Goats have considerable locomotive powers, but they are more used to live in districts; in sheep the brain and intellect are still less. Dogs have a larger brain, and considerable intelligence and memory; the brain is larger than that of the fox, to whom he is so great an enemy; the fox has no power of being made useful to man, for when not thieving or chased, he lies secluded in holes and coverts. Other animals having the most confined stations in holes and coverts, have some quick, but not very enduring locomotive powers; their observations are few, and there is little, therefore, for the voluntary tract to fix in the memory.

The senses of birds are not inferior to those of mammalia, and they have great locomotive powers either in flying or running; their brain is smaller than in mammalia. They observe many things, and fix them through the voluntary tract, and remember them in speaking, singing, noting places, and travelling to distant parts. Amphibia and fishes are not

capable of noticing many impulses, and their small brain does not allow room for impressing them on the sensory.

It may be concluded that the size of the brain is not so much for giving acuteness of intellect in one or two points, as for allowing more enlarged observations and a more copious reception of impulses from the organs of sense, and a capability of imprinting more of them in the sensory, according to the station the animals occupy; in the greatest degree to such mammalia as travel the furthest, for then they require more extended information, and in the least degree to those confined by their habits to small localities, to holes and dens.

THE END.

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