SECT. II.

OF IDEAS, THEIR GENERATION AND ASSOCIATIONS; AND OF THE AGREEMENT OF THE DOCTRINE OF VIBRATIONS WITH THE PHENOMENA OF IDEAS.

PROP. VIII.—Sensations, by being often repeated, leave certain Vestiges, Types, or Images, of themselves, which may be called, Simple Ideas of Sensation.

I took notice in the Introduction, that those ideas which resemble sensations were called ideas of sensation; and also that they might be called simple ideas, in respect of the intellectual ones which are formed from them, and of whose very essence it is to be complex. But the ideas of sensation are not entirely simple, since they must consist of parts both co-existent and successive, as the generating sensations themselves do.

Now, that the simple ideas of sensation are thus generated, agreeably to the proposition, appears, because the most vivid of these ideas are those where the corresponding sensations are most vigorously impressed, or most frequently renewed; whereas, if the sensation be faint, or uncommon, the generated idea is also faint in proportion, and, in extreme cases, evanescent and imperceptible. The exact observance of the order of place in visible ideas, and of the order of time in audible ones, may likewise serve to shew, that these ideas are copies and offsprings of the impressions made on the eye and ear, in which the same orders were observed respectively. And though it happens, that trains of visible and audible ideas are presented in sallies of the fancy, and in dreams, in which the order of time and place is different from that of any former impressions, yet the small component parts of these trains are copies of former impressions; and reasons may be given for the varieties of their compositions.

It is also to be observed, that this proposition bears a great resemblance to the third; and that, by this resemblance, they somewhat confirm and illustrate one another. According to the third proposition, sensations remain for a short time after the impression is removed; and these remaining sensations grow feeble and feeble, till they vanish. They are therefore, in some part of their declension, of about the same strength with ideas, and in their first state, are intermediate between sensations and ideas. And it seems reasonable to expect, that, if a single sensation can leave a perceptible effect, trace, or vestige, for a short time, a sufficient repetition of a sensation may leave a perceptible effect of the same kind, but of a more permanent nature, i.e. an idea, which shall recur occasionally, at long distances of time, from the impression of the corresponding sensation, and vice versd. As to the occasions and causes, which make ideas recur, they will be considered in the next proposition but one.

The method of reasoning used in the last paragraph is farther confirmed by the following circumstance; viz. that both the diminutive declining sensations, which remain for a short space after the impressions of the objects cease, and the ideas, which are the copies of such impressions, are far more distinct and vivid, in respect of visible and audible impressions, than of any others. To which it may be added, that, after travelling, hearing music, &c. trains of vivid ideas are very apt to recur, which correspond very exactly to the late impressions, and which are of an intermediate nature between the remaining sensations of the third proposition, in their greatest vigour, and the ideas mentioned in this.

The sensations of feeling, taste and smell, can scarce be said to leave ideas, unless very indistinct and obscure ones. However, as analogy leads one to suppose that these sensations may leave traces of the same kind, though not in the same degree, as those of sight and hearing; so the readiness with which we reconnoitre sensations of feeling, taste, and smell, that have been often impressed, is an evidence that they do so; and these generated traces or dispositions of mind may be called the ideas of feeling, taste, and smell. In sleep, when all our ideas are magnified, those of feeling, taste, and smell, are often sufficiently vivid and distinct; and the same thing happens in some few cases of vigilance.

PROP. IX.—Sensory Vibrations, by being often repeated, beget, in the medullary Substance of the Brain, a Disposition to diminutive Vibrations, which may also be called Vibratuncules, and Miniatures, corresponding to themselves respectively.

This correspondence of the diminutive vibrations to the original sensory ones, consists in this, that they agree in kind, place, and line of direction; and differ only in being more feeble, i.e. in degree.

This proposition follows from the foregoing. For since sensations, by being often repeated, beget ideas, it cannot but be that those vibrations, which accompany sensations, should beget something which may accompany ideas in like manner; and this can be nothing but feeble vibrations, agreeing with the sensory generating vibrations in kind, place, and line of direction.

Or thus: By the first proposition it appears, that some motion must be excited in the medullary substance, during each sensation; by the fourth, this motion is determined to be a vibratory one: since therefore some motion must also, by the second, be excited in the medullary substance during the presence of each idea, this motion cannot be any other than a vibratory one: else how should it proceed from the original vibration attending the sensation, in the same manner as the idea does from the sensation.
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itself? It must also agree in kind, place, and line of direction, with the generating vibration. A vibratory motion, which recurs \( t \) times in a second, cannot beget a diminutive one that recurs \( \frac{1}{2} t \) or \( 2 \) times; nor one originally impressed on the region of the brain corresponding to the auditory nerves, beget diminutive vibrations in the region corresponding to the optic nerves; and so of the rest. The line of direction must likewise be the same in the original and derivative vibrations. It remains therefore, that each simple idea of sensation be attended by diminutive vibrations of the same kind, place, and line of direction, with the original vibrations attending the sensation itself: or, in the words of the proposition, that sensory vibrations, by being frequently repeated, beget a disposition to diminutive vibrations corresponding to themselves respectively. We may add, that the vibratory nature of the motion which attends ideas, may be inferred from the continuance of some ideas, visible ones for instance, in the fancy for a few moments.

This proof of the present proposition from the foregoing appears to be incontestable, admitting the fourth: however, it will much establish and illustrate the doctrines of vibrations and association, to deduce it directly, if we can, from the nature of vibratory motions, and of an animal body; and not only from the relation between sensations and ideas. Let us see, therefore, what progress we can make in such an attempt.

First, then, if we admit vibrations of the medullary particles at all, we must conceive, that some take place in the \textit{fetus in utero}, both on account of the warmth in which it lies, and of the pulsation of those considerable arteries, which pass through the medullary substance, and which consequently must compress and agitate it upon every contraction of the heart. And these vibrations are probably either uniform in kind and degree, if we consider short spaces of time; or, if long ones, increase in a slow uniform manner, and that in degree only, as the \textit{fetus in utero} increases in bulk and strength. They are also probably the same in all the different regions of the medullary substance. Let these vibrations be called the \textit{natural vibrations}.

Secondly, As soon as the child is born, external objects act upon it violently, and excite vibrations in the medullary substance, which differ from the natural ones, and from each other, in degree, kind, place, and line of direction. We may also conceive that each region of the medullary substance has such a texture as to receive, with the greatest facility, the several specific vibrations, which the objects corresponding respectively to these regions, i.e. to their nerves, are most disposed to excite. Let these vibrations be, for the present, called \textit{pretenernal ones}, in contradistinction to those which we just now called \textit{natural ones}.

Thirdly, Representing now the natural vibrations by \( N \), and the preteterminal ones, from various objects, by \( A, B, C, \&c. \) let us suppose the first object to impress the vibrations \( A \), and then to be removed. It is evident from the nature of vibratory motions, that the medullary substance will not, immediately upon the removal of this object, return to its natural state \( N \), but will remain, for a short space of time, in the preteterminal state \( A \), and pass gradually from \( A \) to \( N \). Suppose the same object to be impressed again and again, for a sufficient number of times, and it seems to follow, that the medullary substance will be longer in passing from \( A \) to \( N \), after the second impression than after the first. after the third impression than the second, &c., till, at last, it will not return to its natural original state of vibration \( N \) at all, but remain in the preteterminal state \( A \), after the vibrations have fallen to a diminutive pitch, their kind and place, or chief seat, and their line of directions, continuing the same. This state may therefore be fitly denoted by \( a \), and, being now in the place of the natural state \( N \), it will be kept up by the heat of the medullary substance, and the pulsation of its arteries. All this seems to follow from the above-mentioned disposition of animal bodies to accommodate themselves to, and continue in, almost any state that is often impressed; which is evident from innumerable both common and medical observations, whatever be determined concerning the manner of explaining and accounting for these facts. For the alterations which habit, custom, frequent impression, &c. make in the small constituent particles, can scarce be anything besides alterations of the distances, and mutual actions, of these particles; and these last alterations must alter the natural tendency to vibrate. We must, however, here resume the supposition made in the last paragraph, viz. that the several regions of the brain have such a texture as to dispose them to those specific vibrations, which are to be impressed by the proper objects in the events of life. And this will much facilitate and accelerate the transition of the state \( N \) into \( a \); since we are to suppose a predisposition to the state \( A \), or \( a \).

It will somewhat illustrate and confirm this reasoning, to remark, that musical strings always accommodate themselves to, and lean towards the state into which they were last put. Thus the tone of a musical string either rises or falls upon altering its tension, according as the preceding tension was greater or less than its present tension. Now the small component parts of a musical string must recede from, and approach to, each other, i.e. must oscillate lengthways, during every transverse oscillation of the string. And this must arise from the mutual influences of the component particles tending to their last superinduced state. Let us suppose something analogous to this to take place in the component molecules of the brain, the molecules of the molecules, &c. and it will follow, that \( A \) may overpower \( N \), and \( a \) become the natural state. Now, since the human body is composed of the same matter as the external world, it is reasonable to expect, that its component particles should be
subjected to the same subtle laws. And the exquisite structure of animal bodies in so many other respects, makes it easier to conceive, that the organ of organs, viz. the medullary substance, should be endowed with a proper subtle ultimate structure, for the purpose of retaining a state that is frequently impressed. One may guess also, that it is better suited to this purpose during its growth, i.e. in passing from infancy to adult age, than afterwards; as this would be very agreeable to the phenomena.

Fourthly, Suppose now the vibrations $A, B, C, D, \&c.$ belonging to each of the senses, to be excited, and repeated in such order and manner as usually happens to the new-born infant upon its entrance into this new scene of things. It is evident, that these will have a greater power to overrule the natural state $N$, than the vibrations $A$ from one single object could have: for $A$ affected only one region of the medullary substance primarily; whereas $A, B, C, D, \&c.$ affect all the regions primarily in their turn. It is evident also, that the secondary vibrations, or those which are propagated from the region of the medullary substance primarily affected into the rest, will be overruled, in great measure, in each region, by the primary vibrations peculiar to that region. Lastly, it is evident, that of the vibrations which are excited in each region, no one can prevail over all the rest, but each must leave an effect, in proportion to its strength and frequency. We may conceive, therefore, that each region of the medullary substance will have a tendency generated in it to vibrate with vibrations of the same frequency (but weaker in degree) as those which the several appropriated objects impress upon it respectively; and that diminutive vibrations resembling them will rise in succession in each region. For each region may easily be conceived to lean sometimes to the vibrations from one object, sometimes to those from another, according to the strength, frequency, and novelty of the impression, the then present disposition of the nervous system, association (of which in the two next propositions), and other such-like causes. And for the same reason, as in every sense the idea of some one object of that sense must prevail over all the rest, we may conclude, that sometimes the ideas belonging to one sense, sometimes those belonging to another, will prevail over the rest.

Or thus: Some vibrations there must always be in the medullary substance, on account of its heat, and the pulsation of the arteries which pass through it. These cannot be the natural ones $N$, because they will soon be overruled by the great force and variety of impressions made on the new-born infant, which must also dispose each region of the brain to lean to some or other of those vibrations which are excited in it primarily. Hence we may conceive, that a very complex set of vibrations, arising from the mixture and combinations of degree, kind, place, and line of direction, exists always in the medullary substance, being kept up by its heat, and the pulsation of its arteries, when other causes are wanting, almost in the same manner as in a concert of music the air is agitated by vibrations of a very complex kind. But then, as in a concert, some one instrument generally strikes the ear more than the rest, so of the complex vibrations which exist in the medullary substance, some one part will prevail over the rest, and present the corresponding idea to the mind. Some region must be disposed, at each instant, to vibrate stronger than the rest; and of the specific vibrations which are generally impressed upon this region, some one will have a more favourable concurrence of circumstances than the rest. And thus it will follow, according to the terms of the proposition, that sensory vibrations, by being sufficiently repeated, will beget a disposition to miniature vibrations corresponding to them respectively; or, using the appellations above assumed, that $A, B, C, \&c.$ will beget $a, b, c, \&c.$

If we allow the proof of this proposition thus deduced from the nature of vibratory motions, and of an animal body, the foregoing proposition will follow from it, and hold equally, in respect of the senses of feeling, taste, and smell, as of sight and hearing. Or, in other words, if we allow that original impressed vibratory motions leave a tendency to miniature ones of the same kind in the sense and line of direction, it will follow, that sensations must beget ideas, and that not only in the senses of sight and hearing, where the ideas are sufficiently vivid and distinct, but in the three others, since their sensations are also conveyed to the mind by means of vibratory motions. We may also perhaps discover hereafter, from the nature of vibratory motions, and of the human brain, compared with the circumstances of life, why the ideas of one sense are more vivid and distinct than those of another.

PROP. X.—Any Sensations $A, B, C, \&c.$ by being associated with one another a sufficient Number of Times, get such a Power over the corresponding Ideas $a, b, c, \&c.$ that any one of the Sensations $A$ when impressed alone, shall be able to excite in the Mind, $b, c, \&c.$ the Ideas of the rest.

Sensations may be said to be associated together, when their impressions are either made precisely at the same instant of time, or in the contiguous successive instants. We may therefore distinguish association into two sorts, the synchronous, and the successive.

The influence of association over our ideas, opinions, and affections, is so great and obvious, as scarcely to have escaped the notice of any writer who has treated of these, though the word association, in the particular sense here affixed to it, was first brought into use by Mr. Locke. But all that has been delivered by the ancients and moderns, concerning the power of habit, custom, example, education, authority, party-prejudice, the
and connects them together. In this it somewhat resembles the first letter of a word, or first word of a sentence, which are often made use of to bring all the rest to mind.

Cor. VIII. When objects and ideas, with their most common combinations, have been often presented to the mind, a train of them, of a considerable length, may, by once occurring, leave such a trace, as to recur in imagination, and in miniature, in nearly the same order and proportion as in this single occurrence. For, since each of the particular impressions and ideas is familiar, there will want little more for their recurrence, than a few connecting links; and even these may be, in some measure, supplied by former similar instances. These considerations, when duly unfolded, seem to me sufficient to explain the chief phenomena of memory; and it will be easily seen from them, that the memory of adults, and masters in any science, ought to be much more ready and certain than that of children and novices, as it is found to be in fact.

Cor. IX. When the pleasure or pain attending any sensations and ideas is great, all the associations belonging to them are much accelerated and strengthened. For the violent vibrations excited in such cases, soon overrule the natural vibrations, and leave in the brain a strong tendency to themselves, from a few impressions. The associations will therefore be cemented sooner and stronger than in common cases; which is found agreeable to the fact.

Cor. X. As many words have complex ideas annexed to them, so sentences, which are collections of words, have collections of complex ideas, i.e. have decomplex ideas. And it happens, in most cases, that the decomplex idea belonging to any sentence is not compounded merely of the complex ideas belonging to the words of it; but that there are also many variations, some oppositions, and numberless additions. Thus, propositions, in particular, excite, as soon as heard, assent or dissent; which assent and dissent consist chiefly of additional complex ideas, not included in the terms of the proposition. And it would be of the greatest use, both in the sciences and in common life, thoroughly to analyze the matter, to shew in what manner, and by what steps, i.e. by what impressions and associations, our assent and dissent, both in scientific and moral subjects, is formed.

Prop. XIII. When simple Ideas run into a complex one, according to the foregoing Proposition, we are to suppose, that the simple miniature Vibrations corresponding to those simple Ideas, run in like manner, into a complex miniature Vibrations, corresponding to the resulting complex Idea.

This proposition is analogous to the ninth and eleventh, and may be deduced from the last, as they are from the eighth and tenth respectively. It is also an evidence and illustration of the second; shewing, not only that the state of the medullary substance is changed, according to the several natures of the ideas which are presented to the mind; but also shewing, in general, of what kind this change is, and in what manner it is effected.

Prop. XIV. It is reasonable to think, that some of the complex Vibrations attending upon complex Ideas, according to the last Proposition, may be as vivid as any of the sensory Vibrations excited by the direct Action of Objects.

For these complex vibrations may consist of so many parts co-existent and successive, and these parts may so alter and exalt one another, as that the resulting agitations in the medullary substance may no longer be miniature vibrations, but vivid ones equal to those excited by objects impressed on the senses. This process may be farther favoured by a mixture of vivid real impressions among the ideas, by the irritability of the medullary substance, by a previous disposition to the vibrations to be excited, &c.

Cor. I. When the complex miniature vibrations are thus exalted in degree, we are to conceive, that the corresponding complex ideas are proportionally exalted, and so pass into intellectual affections and passions. We are therefore to deduce the origin of the intellectual pleasures and pains, which are the objects of these affections and passions, from the source here laid open.

Cor. II. Since the present proposition unfolds the nature of affections and will, in the same manner, and from the same principles, as the twelfth does that of ideas, intellect, memory, and fancy; it follows, that all these are of the same original and consideration, and differ only in degree, or some accidental circumstances. They are all deducible from the external impressions made upon the senses, the vestiges or ideas of these, and their mutual connexions by means of association, taken together and operating on one another.

Cor. III. It follows also from this proposition, that the intellectual pleasures and pains may be greater, equal, or less, than the sensible ones, according as each person unites more or fewer, more vivid or more languid, miniature vibrations in the formation of his intellectual pleasures and pains, &c.

Cor. IV. It is evident, that all the vibrations which belong to ideas, and intellectual affections, must reside in the brain, or even in the most internal parts of it, not in the spinal marrow or nerves. The brain is therefore the seat of the rational soul, i.e. of the soul, as far as it is influenced by reasons and moral motives, even though we should admit, that the spinal marrow and nerves, are, in part, the sensorium, or the seat of the sensitive soul; which is some argument, that this ought not to be